# INSTRUCTION MANUAL

## MODELS 120, 123

## WAVEFORM GENERATORS

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# IF YOUR INSTRUMENT DOES NOT OPERATE

## PLEASE

1. Check operating procedure in manual for proper setup.

2. Check fuse and power supply voltages.

3. Call your Exact representative or factory. Instruments returned to the factory will be accepted only if they are sent freight prepaid, unless Exact or factory representative has authorized otherwise.

## CLAIM FOR DAMAGED SHIPMENT

The instrument should be inspected as soon as received. If damage has occurred, a claim should be made with the carrier. The claim agent should receive a complete report of damage and a copy sent to Exact. After receiving this report, Exact will advise you of the dispostion of the instrument and arrange for its repair or replacement.

## WARRANTY

Exact warrants its instruments to be free from defects in material and workmanship under normal use for a period of twelve months from the original date of shipment. Exact's obligation is limited to repair or replacement.

All repairs and replacements made under this warranty are f.o.b. Exact's factory or designated service depot unless otherwise authorized by Exact. This warranty is made on condition that prompt notice of defect is given to Exact, in writing, within the warranty period and that Exact shall have the sole right to determine whether in fact a defect exists.

This warranty does not apply to any instrument which has been repaired or altered by other than Exact's own service representative so as, in Exact's judgment, to adversely affect it, nor which has been subject to misuse, negligence or accident or which has been operated contrary to sound practice or operating instructions.

SECTION 1

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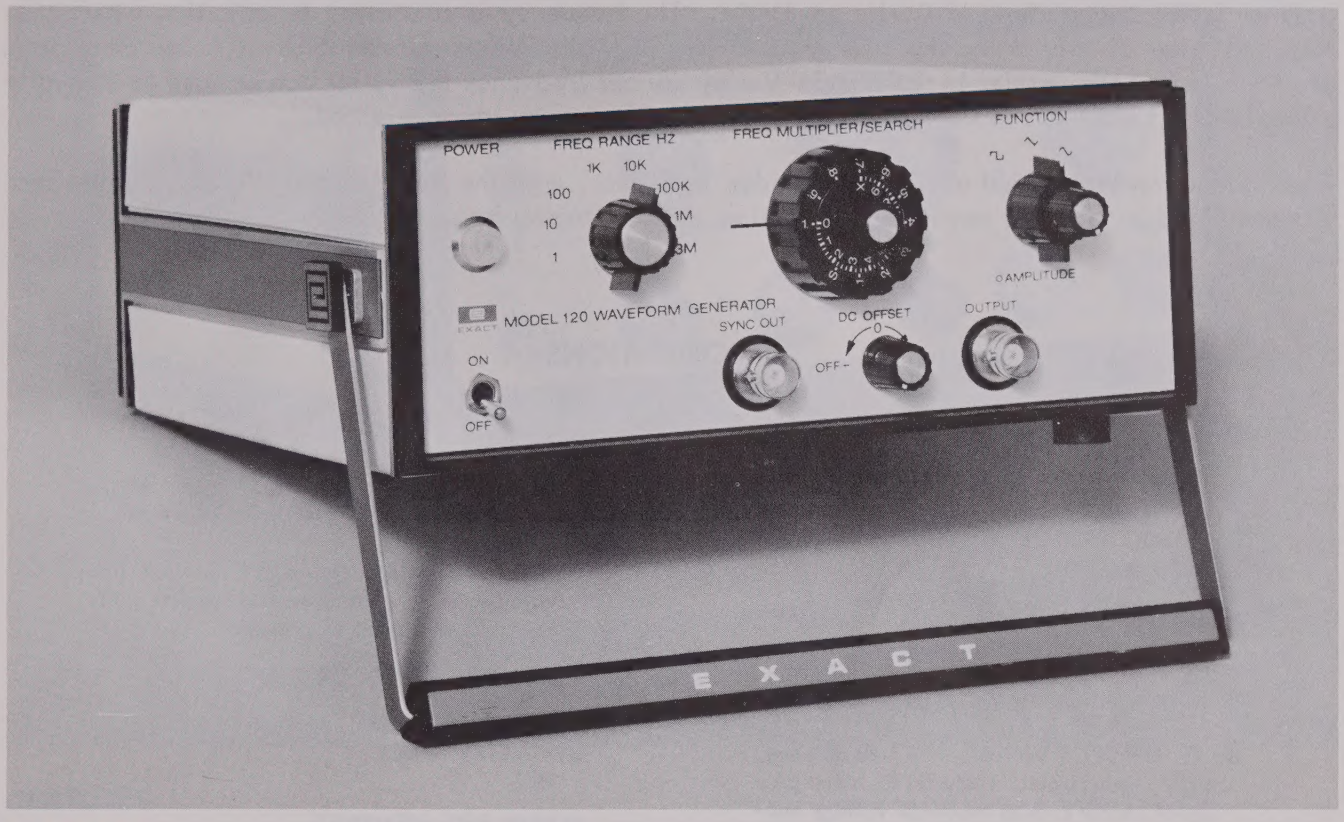
# SECTION 2

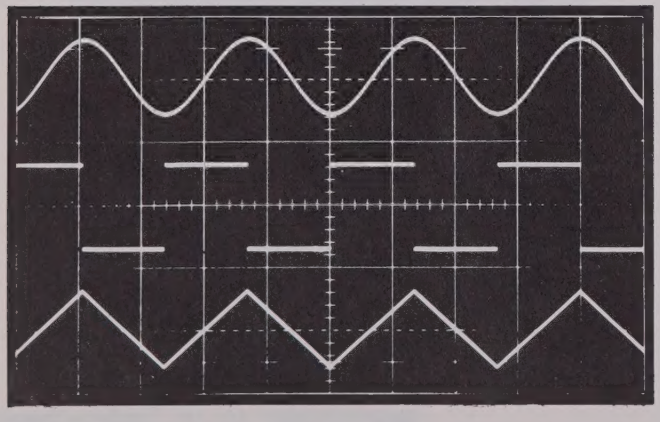
# SPECIFICATIONS

# MODEL 120 WAVEFORM GENERATOR




## FEATURES

- FLOATING OUTPUT PROVISION
- KELVIN-VARLEY DIVIDER FREQUENCY CONTROL
- CONVENIENT HANDLE/TILT STAND
- 0.1Hz TO 3MHz FREQUENCY RANGE
- SEARCH MODE FOR MANUALLY SWEEPING OVER THREE DECADES
- MINIATURE SIZE
- VARIABLE D.C. OFFSET



SINE, SQUARE AND TRIANGLE
(output phase relationship)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## GENERAL

The Model 120 waveform generator is a precision source of sine, square and triangle waveforms over a dynamic frequency range of 0.1Hz to 3MHz. The frequency is controlled by adjusting a precision Kelvin-Varley divider at the input for greater accuracy, stability and resetability. A Search mode is provided so that the vernier in the Kelvin-Varley divider frequency multiplier can be used to manually sweep over a 1000:1 (three decade ) range within the frequency range selected.

Cost is comparable to that of the Wein Bridge oscillator, with the inherent stability of the waveform generator and without the need for settling time when changing frequency.

## SPECIFICATIONS

WAVEFORMS
Sine, Square, Triangle and Sync

DYNAMIC FREQUENCY RANGE
0.1Hz to 3MHz

MAIN OUTPUT
50-ohm output impedance
All waveforms >20V P-P open circuit,
>10V P-P into 50 ohms.

D. C. OFFSET: Variable ±5V into 50 ohms, ±10V, open circuit. Note D. C. offset plus signal cannot exceed maximum voltage output or clipping will occur.

SYNC OUTPUT
Square wave approx 2V P-P open circuit, 100-ohm output impedance.

FREQUENCY MULTIPLIER (Kelvin-Varley Divider) ACCURACY
±2% of Frequency range (typically ±2% of setting).

SINE WAVE DISTORTION
<0.5%, 0.1Hz to 100KHz (typically < 0.2%). Harmonics at least 30db down from fundamental to 3MHz (typically 38 to 42db down).

SINE FREQUENCY RESPONSE
0.1db to 100KHz; 0.5db to 3MHz

SQUARE WAVEFORM
Rise and fall <60 nanoseconds.
Overshoot and ringing < 5%.

TRIANGLE LINEARITY
99% to 100KHz, 95% to 3MHz

FREQUENCY STABILITY
0.04% of setting for 10 minutes,
0.2% of setting for 24 hours.

AMPLITUDE STABILITY
0.05% of max P-P amplitude for 10 min.,
0.2% of max P-P amplitude for 24 hrs.

NOTE: All stabilities are for constant line voltage and temperature and do not apply in the Search mode of operation.

SYMMETRY ABOUT GROUND
±1%

SYMMETRY (Time)
99%

POWER REQUIREMENTS
Input Voltage - 115 VAC ±10%, or
220 VAC ±10%.
Frequency - 50 to 400Hz.
Power Consumption - less than 10W

PHYSICAL CHARACTERISTICS
7-3/8"W x 2-7/8"H x 8-1/2"D.
Weight 4 lbs net, 6 lbs shipping.
Top and bottom covers easily removable, exposing all calibration and circuit board areas.

PRICE

NOTE: (unless otherwise stated).
Specifications apply when amplitude control is CW and output terminated into 50 ohms and do not apply in the Search mode. Specifications are valid at 25°C ±5°C and with 105-125 VAC or 200-250 VAC line voltage applied. For operation at 0-50°C, derate all specifications by a factor of 2.5. Prices and specifications are subject to change without notice.

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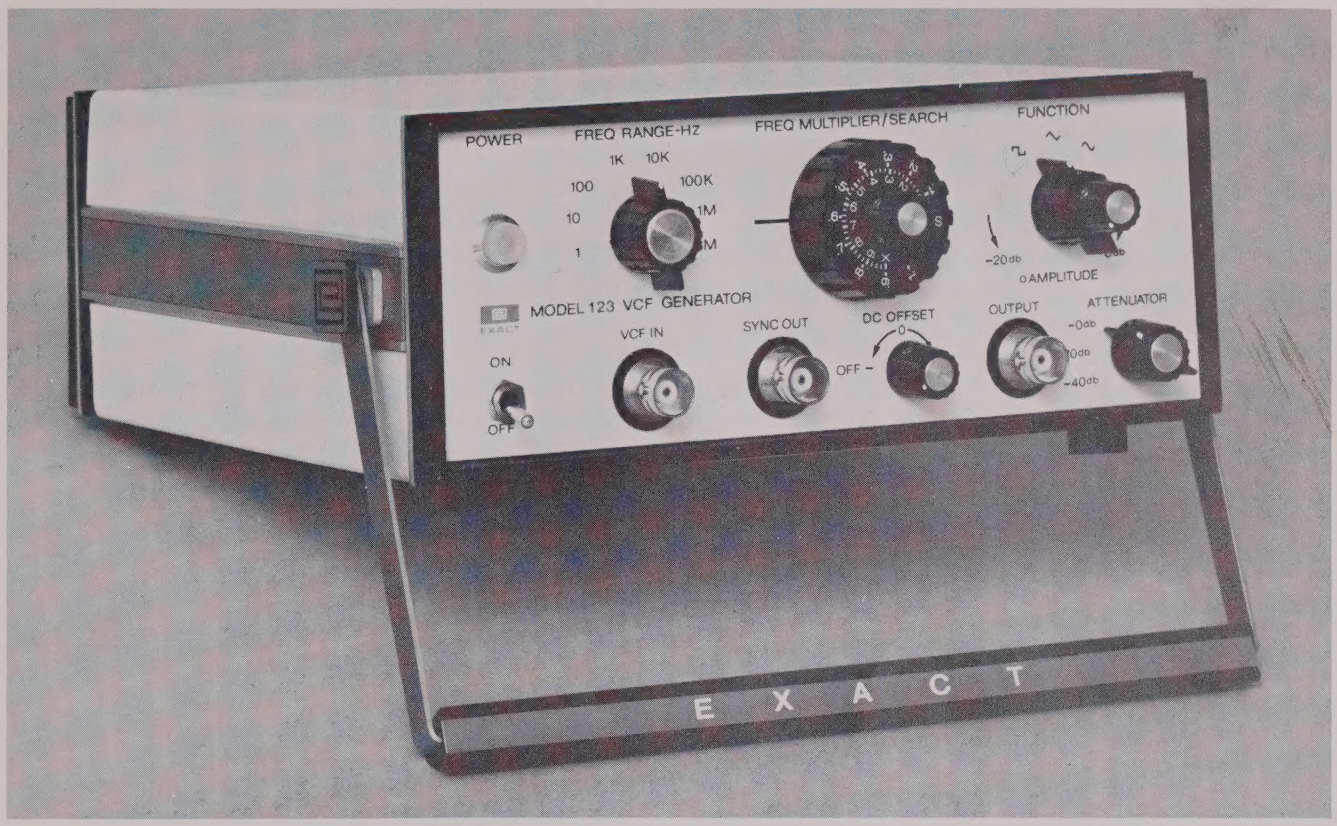
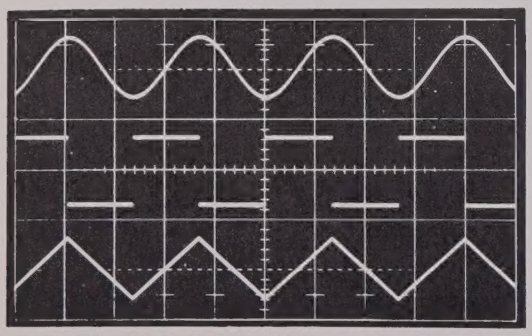
# MODEL 123 VCF WAVEFORM GENERATOR

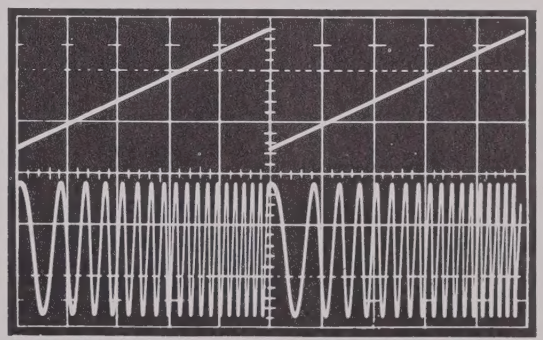



## FEATURES

- 1000:1 SWEEP CAPABILITY
- SEARCH MODE FOR MANUALLY SWEEPING OVER THREE DECADES
- VARIABLE D.C. OFFSET
- CALIBRATED OUTPUT STEP ATTENUATOR
- FLOATING OUTPUT PROVISION
- KELVIN-VARLEY DIVIDER FREQUENCY CONTROL
- MINIATURE SIZE
- CONVENIENT HANDLE/TILT STAND



SINE, SQUARE AND TRIANGLE
(output phase relationship)



VOLTAGE CONTROLLED FREQUENCY
(VCF input driven with external ramp)

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## GENERAL

The Model 123 VCF generator is a precision source of sine, square, triangle and sync waveforms. Frequency is controlled by adjusting a Kelvin-Varley divider at the input for greater accuracy, stability and resetability or by application of an external control voltage. The control voltage can be either D.C. programming or wide-band A.C. frequency modulation.

The Model 123 is capable of being swept or A.C. modulated over a 1000:1 frequency ratio. A Search mode is provided so that the vernier in the Kelvin-Varley divider frequency multiplier can be used to manually sweep over a 1000:1 (three decades) range within the frequency range selected.

Electronic components are mounted on one printed circuit board. Calibration adjustments and test points are printed on the top side of the printed circuit board and the calibration procedure is printed inside the top cover.

Cost is comparable to that of the Wein Bridge oscillator, with the inherent stability and other advantages of the voltage-controlled function generator.

## SPECIFICATIONS

WAVEFORMS: Sine, Square, Triangle and Sync

DYNAMIC FREQUENCY RANGE: 0.1Hz to 3MHz

SYNC OUTPUT: Square wave approximately 2V P-P open circuit. 100-ohm output impedance.

FREQUENCY MULTIPLIER (Kelvin-Varley Divider) ACCURACY

±2% of frequency range
(typically ±2% of setting)

MAIN OUTPUT: 50 ohms output impedance
All waveforms >20V P-P open circuit,
>10V P-P into 50 ohms.
A full 60db of attenuation is provided with 20db steps.

VCF (Voltage-Controlled Frequency): Approx 5V input for 1000:1 (three decades) frequency ratio. VCF input is usable to 1MHz input frequency.

SINE WAVE DISTORTION: <0.5% 0.1Hz to 100KHz (typically 0.2%). No harmonics <30db down 100KHz to 3MHz (typically 38 to 42db down).

SINE FREQUENCY RESPONSE: 0.1db to 100KHz; 0.5db to 3MHz.

SQUARE WAVEFORM: Rise and fall <60 nanosec. Overshoot and ringing <5%.

TRIANGLE LINEARITY: 99% to 100KHz, 95% to 3MHz.

D.C. OFFSET: Variable ±5V into 50 ohms, ±10V, open circuit. Note D.C. offset plus signal cannot exceed maximum voltage output or clipping will occur.

FREQUENCY STABILITY: 0.04% of setting for 10 min., 0.2% of setting for 24 hours.

AMPLITUDE STABILITY: 0.05% of max P-P amplitude for 10 min., 0.2% of max P-P amplitude for 24 hrs.

Note; All stabilities are for constant line voltage and temperature and do not apply in the Search mode of operation.

SYMMETRY (time): 99%

POWER REQUIREMENTS:
Input Voltage - 115 VAC ±10% or 220 VAC ±10%.
Frequency - 50 to 400Hz, Power Consumption 10W.

PHYSICAL CHARACTERISTICS:
7-3/8"W x 2-7/8"H x 8-1/2" D.
Weight 4 lbs net, 6 lbs shipping.
Top and bottom covers easily removable, exposing all calibration and circuit board areas.

PRICE:

NOTE: (unless otherwise stated).
Specifications apply from 10% to full amplitude with output terminated into 50 ohms and do not apply in the Search Mode. Specifications are valid at 25°C±5°C and with 105-125 VAC or 200-250 VAC line voltage applied. For operation at 0-50°C, derate all specifications by a factor of 2.5. Prices and specifications are subject to change without notice.

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# SECTION 3

# FRONT PANEL FAMILIARITY

# OPERATING INSTRUCTIONS

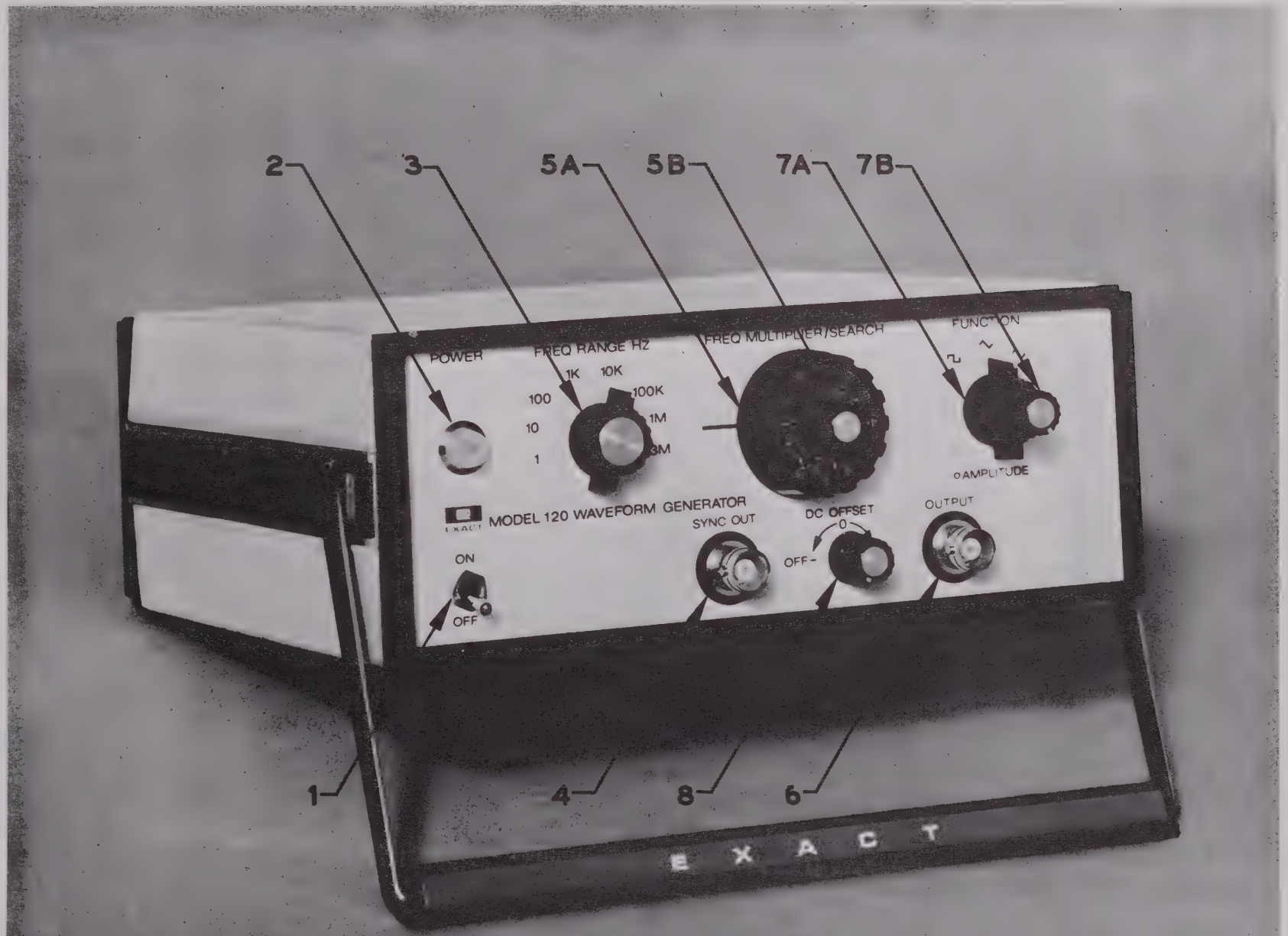



FIGURE 3.1.1 FRONT PANEL MODEL 120

## 3.1.1 FRONT PANEL FAMILIARITY, MODEL 120

1. Power On/Off Switch - turns on input power to instrument.

2. Pilot lamp - indicates input power On.

3. Range switch - selects frequency range of output waveform.

4. Sync Out connector - provides trigger output voltage in phase with the square waveform.

5. Multiplier dial - Kelvin-Varley type multiplier provides vernier frequency control of output waveform.

6. Output connector - provides 50-ohm output impedance of selected waveform.

7a. Function switch - selects square, triangle or sine.

7b. Amplitude control - amplitude adjust of output waveform.

8. D.C. Offset control - selects D.C. offset amplitude (also has Off position).

NOTE: This instrument is equipped with a floating circuit ground which may be tied to the chassis ground or floated to some other source by the connection of the grounding strap on the rear panel.

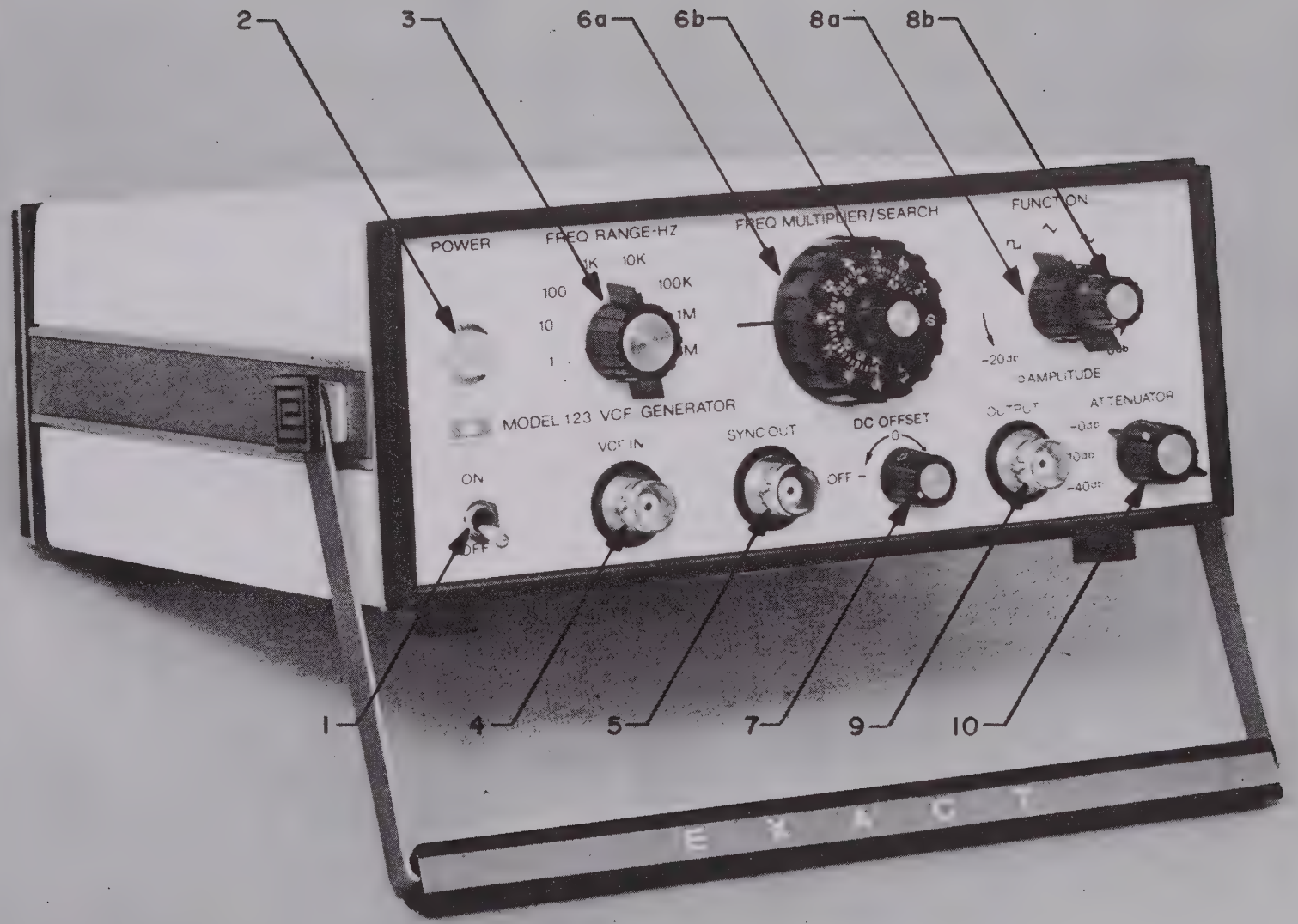



FIGURE 3.1.2 FRONT PANEL MODEL 123

## 3.1.2 FRONT PANEL FAMILIARITY, MODEL 123

1. Power On/Off switch - turns on input power to instrument.

2. Pilot lamp - indicates input power On.

3. Range switch - selects frequency range of output waveform.

4. VCF input - input connector for external frequency control.

5. Sync Out connector - provides trigger output voltage in phase with the square waveform.

6. Multiplier dial - Kelvin-Varley type multiplier provides vernier frequency control of output waveform.

7. D.C. Offset control - selects D.C. offset amplitude (also has Off position).

8a. Function switch - selects square, triangle or sine.

8b. Amplitude control - vernier amplitude adjust of output waveform.

9. Output connector - provides 50-ohm output impedance of selected waveform.

10. Attenuator - selects 20db amplitude steps for clean output waveforms at low amplitude.

NOTE: This instrument is equipped with a floating circuit ground which may be tied to the chassis ground or floated to some other source by the connection of the grounding strap on the rear panel.

## 3.2.0 FIRST TIME OPERATION

NOTE: Before applying power to the instrument, the input power connection should be checked to be certain the instrument has been wired for the correct power supply voltage. Refer to Power Transformer connection on the power supply schematic diagram (fig. 7.2.2). The correct fuse should be in the rear panel fuse holder as specified in the chart on the instrument rear panel.

1. Plug instrument into source of 110V or 220V 50 to 400 cycle A.C. power and turn on power switch. Set controls as follows:

| | |
|---|---|
| RANGE switch | 1KHz |
| MULTIPLIER dial | 1.0 |
| FUNCTION switch | SINE |
| AMPLITUDE vernier | MAX CW |
| D.C. OFFSET | OFF |
| OUTPUT ATTEN | 0db |

2. Connect generator output through 50-ohm coaxial cable into 50-ohm coaxial load and the vertical input of a suitable oscilloscope. The instrument should be providing a 1KHz sine waveform at approximately 10V P-P amplitude under these conditions.

3. Switch Function selector through its various output waveforms and observe on the oscilloscope.

4. Switch the D.C. Offset switch to Variable and observe that a D.C. voltage can be superimposed upon the output voltage by the adjustment of the D.C. offset control potentiometer.

5. The output amplitude can be adjusted over its 60db of dynamic range by the combination of output amplitude vernier and attenuator switch.

6. The frequency of the instrument may be selected by the combination of the proper range switch setting and the Kelvin-Varley multiplier dial settings.

NOTE: It is recommended that the rear panel chassis ground and circuit ground connections be connected together with the grounding strap provided unless it is necessary to float the instrument ground.

# SECTION 4

# CIRCUIT DESCRIPTION

## 4.1.1 INTRODUCTION

The simple block diagram in figure 1 shows the closed loop operation of the function generator. The diode gate allows only one current source to charge the integrating capacitor at a time. Assume that the positive current source is charging the capacitor; this results in a linear rise in voltage, the slope of which is determined by the magnitude of current and the size of the capacitor. When the voltage reaches the trip point of the level detector, the bi-stable switch changes states and the diode bridge switches the integrating capacitor to the negative current source and the voltage level starts moving negative. When the voltage reaches the opposite trip level of the level detector, the bi-stable switch changes states and the process reverses again. The triangle buffer offers a high input impedance so the integrating capacitor is not loaded causing curvature and a low output impedance to drive the level detector and any other required circuitry.

The output of the buffer is a triangle and the level detector output is a square wave. The triangle is applied to a convertor which changes it to a sine wave and the output is amplified back to the level of the triangle. These three outputs can then be applied to a power amplifier.

The frequency can be changed by changing the charging current or the integrating capacitor. Since the triangle amplitude is fixed by the firing points of the level detector, the amplitude of the triangle (and therefore the sine) is constant with changes in frequency. In the Models 120 and 123, the magnitude of current integrating is controlled by the VCF input voltage and the multiplier dial to control the frequency within the range and the range is controlled by selecting the integrating capacitors.

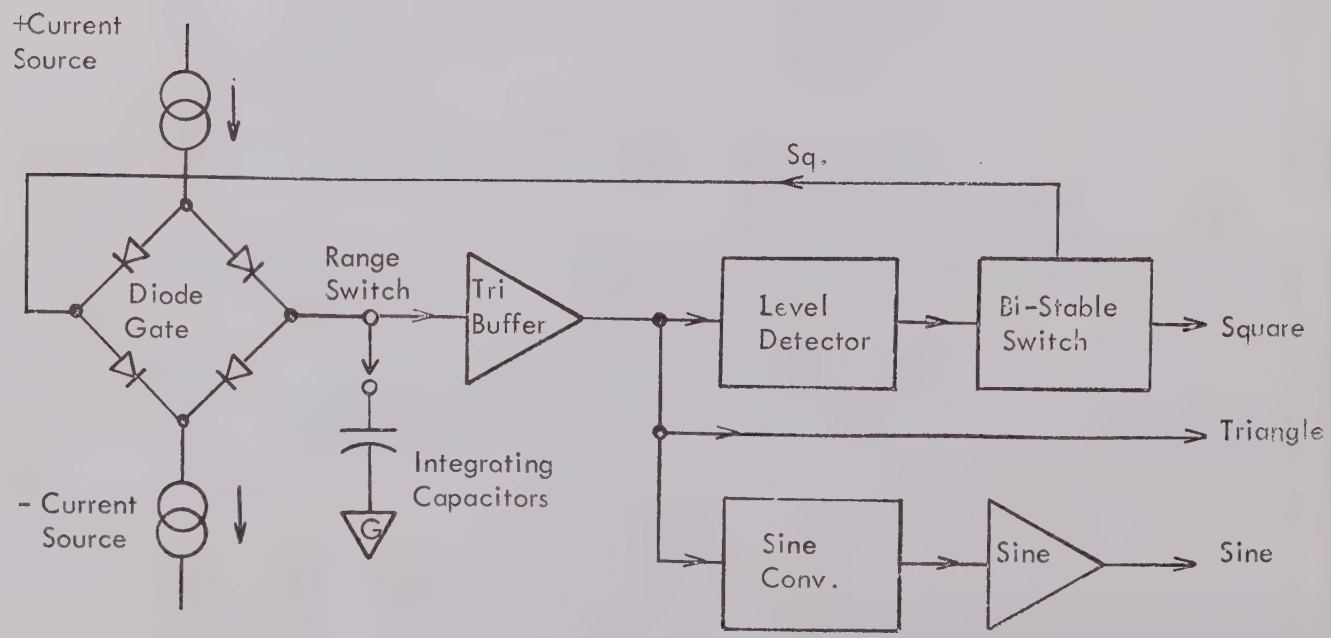



Figure 1

## 4.1.2 CURRENT SOURCES AND INTEGRATOR

Q360, Q370 and associated circuitry make up the positive voltage-controlled current source. Q380, Q390 and their circuitry serve as the negative current source. D370 makes up the diode switching bridge which gates the proper current source into the selected integrating capacitor. S400, the frequency range switch, selects the integrating capacitor and resistors in the current sources.

The preceding circuitry sets the currents in R352 A and B which are in the positive inputs of the current source amplifiers. The selected current source resistors, for example R403 A and B, are in the negative input of the current source amplifiers. Any difference in the currents in the positive and negative inputs is seen as an error signal by the amplifiers and is correct. Field effect transistors Q370 and Q390 isolate the amplifier circuitry from the integrator.

Q330 and Q340 serve as a voltage to current convertor. R340 serves as a current sensing resistor. Any difference between the voltage applied at the positive input of the amplifier (pin 3) and the voltage developed across R340 by the current supplied to the current sources results in an error signal which is corrected by the amplifier, Q330.

Q350B provides a virtual ground for current sense resistor R340, while delivering current to R352A in the positive current source. The emitter of Q350A is connected to ground. Since the transistors are matched, the emitter of Q350B is also at ground. The base emitter voltages of the two transistors track with temperature and the collector of Q350B delivers current to the positive current source. In the Model 120, the frequency control voltage is applied directly to the positive input of Q330 from the frequency multiplier, (Kelvin-Varley divider) S300. In the Model 123, a summing operational amplifier is added, Q320. The voltage from S300 is summed with any D.C. voltage or A.C. modulating voltage applied at the VCF input connector and the frequency is determined by the algebraic sum of the two. R316 sets the voltage applied to the frequency multiplier and therefore the maximum frequency within a selected range. R324 compensates for source current and offset voltage in the summing amplifier so that the frequency remains correct when a low impedance source is connected to the VCF input connector. R333 compensates the offset voltage in the voltage to current convertor and therefore insures that the frequency is correct when small voltages (low frequency end of range) are applied. R354 is used to adjust the balance at very low input voltages and thus sets the time symmetry at the bottom end of the Search mode.

## 4.1.3 TRIANGLE BUFFER AMPLIFIER

Q410 and Q430 serve as a unity gain, high input impedance buffer amplifier for the triangle. The bi-polar transistor Q430 base emitter drops offset and temperature compensate the FET gate voltages resulting in a zero offset, temperature compensated amplifier.

### 4.1.4 LEVEL DETECTOR

Q450 A and B with current source transistor Q470 serve as a simple voltage comparator. The reference level at the base of Q4506 is determined by one of the resistive current sources switched in by diode gate D460 through D463. D451 and D452 limit the collector swing for increased speed. The collectors of Q450 A and B drive a non-saturating current mode switch made up of Q480 through Q510. Q520 is a transistor connected as a Zener diode to supply approximately -7V for the collectors of Q500, Q510 and Q540. The square wave output at the emitter of Q500 drives the diode bridge in the integrator, the diode bridge in the level detector and the sync output circuit, Q550. C432 is a lead capacitor used to compensate for any delays in the loop and keep the triangle from peaking on the highest frequency range.

### 4.1.5 SQUARE BUFFER

Q530 and Q540 drive a diode gating bridge, D531, D532, D541 and D542. The diode bridge switches in one of the two resistive current sources on opposite half cycles to develop the square wave for the power amplifier when the square output is selected. R532 and R542 are adjusted to set the amplitude of the square wave peaks.

### 4.1.6 SYNC OUTPUT

The sync output, Q550, is simply an emitter follower with diode clamping at the output.

### 4.1.7 SINE CONVERTOR AND AMPLIFIER

Diodes D100, D104 and D108 form three diode bridges similar to the bridge used in the integrator. In this case, however, the diode bridges are driven by the triangle and are switched at several different points on the triangle determined by the current source resistors in series with the bridges, R103 through R112. The triangle is attenuated and as each bridge reaches its switch point the slope is changed. This occurs on both half cycles and the result is a low level sine wave across R116.

The sine amplifier is made up of two differential stages, Q120 and Q150 driving an isolation emitter follower, Q170. Diodes D170 and D180 prevent cross-over distortion in the push-pull emitter follower, Q180 and Q190. The feedback network of R135 through R137 sets the gain so that the sine wave is equal in amplitude to the triangle. Q140 serves as a current source for the input differential pair. S200, the function switch, delivers the triangle to the sine convertor in only the sine position and selects the output of the sine amplifier to be delivered to the power amplifier.

### 4.1.8 POWER AMPLIFIER (Main Output)

S200 selects the desired function and delivers it to amplitude control R202. In the Model 123, R202 gives a little more than 20db of attenuation in the counterclockwise position. In the Model 120, R204 gives approximately 40db attenuation. The power

4.1.8 POWER AMPLIFIER (continued)

amplifier is made up of two differential stages driving a push-pull emitter follower. Q220 serves as a current source for differential pair Q200 A and B. D230 and D240 bias the push-pull emitter follower Q250 and Q260 to prevent cross-over distortion. The feedback network of R213 through R215 adjusts the gain of the amplifier and C210 is adjusted for optimum transient response. R218 is the internal D.C. balance (offset) adjustment. R219 is the front panel ±5V D.C. offset control and S219 is the D.C. offset "off" switch in the CCW rotation. R270 through R274 (used in Model 123 only) make up two 20db step attenuators that can be selected by the front panel attenuator switch, S200.

4.1.9 POWER SUPPLIES

A.C. power is applied through F1 and S1, the power switch, to transformer T1. The primaries of T1 are connected in parallel for 117V operation and in series for 220V operation. Full wave rectification is supplied by diode bridge D1 and filtering by C1 and C2, giving unregulated D.C. outputs of ±22V D.C. These voltages are used in the power amplifier, the positive and negative current source in the main generator, and are applied to the positive and negative 12V regulators Q10 and Q40. Divider R10, R12 and R13 adjust the voltage to be compared to reference voltage developed in Q10. R10 is adjusted for no error to integrated power supply Q10 when the regulated output is +12V. Q20 is the series pass transistor. Q40 serves as an amplifier to compare the -12V supply to the +12V supply and to amplify any error to maintain the minus supply equal to the positive supply but of opposite polarity. The output of Q40 is applied to Q50 and Q60 to provide additional current gain. Q65 provides short circuit protection for the negative supply.

# SECTION 5

# CALIBRATION

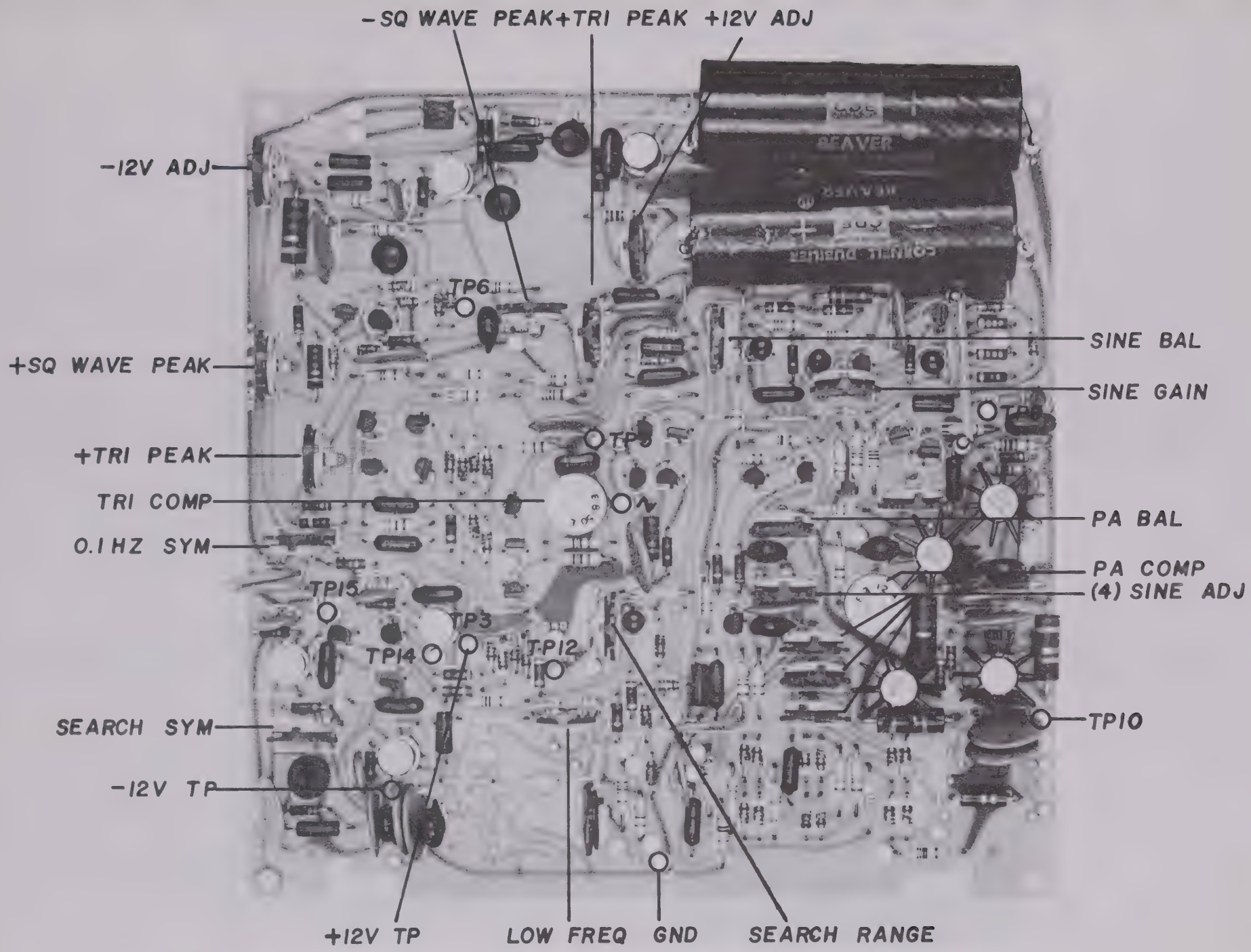



FIGURE 5.3.1 MODEL 120 ADJUSTMENTS & TEST POINTS

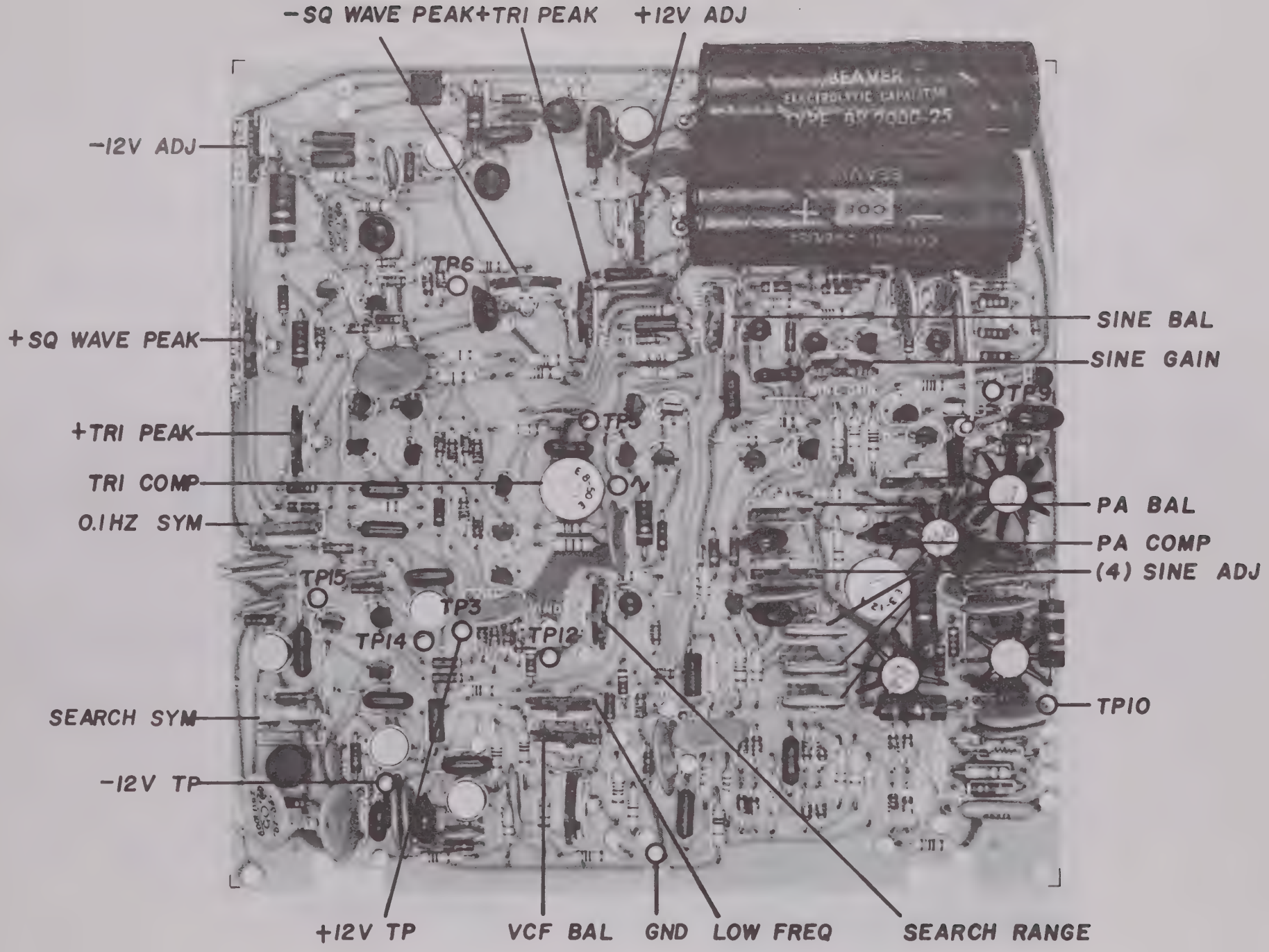



FIGURE 5.3.2 MODEL 123 ADJUSTMENTS & TEST POINTS

SECTION 5 CALIBRATION

## 5.1.0 EQUIPMENT REQUIRED

The following test equipment or suitable equivalents of known accuracy are required for complete calibration of the Models 120 and 123 waveform generators.

Oscilloscope, D.C. to 50MHz bandwidth, Tektronix 545 with 1A1 and W or 1A5 plug-ins, or equivalent.
Distortion analyzer, Hewlett-Packard 333A or equivalent.
Adjustable line voltage transformer, superior powerstat or equivalent.
Constant voltage power supply accurate to 1MV.
Frequency and time interval counter, Fairchild or equivalent.
Differential or digital voltmeter, Fairchild Model 7000 or equivalent.

## 5.2.0 INITIAL CONTROL SETTINGS

| | |
|---|---|
| RANGE | 1KHz |
| MULTIPLIER | X1.0 |
| FUNCTION | TRIANGLE |
| OFFSET adj. | CCW (off) - Model 123 only |
| OUTPUT ATTEN | 0db - Model 123 only |
| OUTPUT VERNIER | FULL CW |
| POWER switch | ON |

## 5.3.0 CALIBRATION

1. Connect voltmeter from TP3 to ground. Adjust +12 VOLT ADJ for +12.00V ± 10mv.

2. Connect voltmeter from TP4 to ground. Adjust -12 VOLT ADJ for -12.00V ± 10mv.

3. Connect terminated cable from output connector to distortion analyzer and adjust 4 SINE adjustments and ± TRI PEAKS for minimum harmonic distortion.

4. Set Range to 100K, Multiplier to S.O Model 123 only: Connect 50-ohm cable terminated in 50 ohms from output connector to input of counter. Alternately short and open the center connector of the VCF input to ground. Adjust VCF bal for no change in frequency when the VCF input is shorted.

5. RESET RANGE to 1K and Multiplier to 1.00, adjust TOP FREQ for 1.00KHz ± 1%.

6. Change Multiplier to 0.1. Adjust LOW FREQ ADJ for 100.0Hz ± 1%. Repeat steps 5 and 6 if necessary. Check multiplier dial tracking.

7. Set Multiplier dial to 1.00. Connect 50 ohm cable terminated in 50 ohms from output connector to oscilloscope. Adjust P.A. BAL for symmetry about ground ± 100MV.

8. Set Function to square. Adjust +SQ WAVE ADJ for +5V(+100MV, -0MV) and -SQ WAVE SYMMETRY to -5V(-100MV, +0MV).

5.3.0 CALIBRATION (continued)

9. Set Function to sine. Adjust SINE GAIN for 10V P-P +100MV -OMV sine wave Adjust SINE BAL for symmetry about ground.

10. Set RANGE to 1MHz. Adjust HF COMP for 1MHz ± 2%. Set Range to 3MHz. Adjust 3MHz ADJ for 3MHz ± 2%. NOTE: 3MHz adjustment is located on range switch in parallel with 270PF capacitor.

11. Adjust P.A. COMP for optimum square wave with minimum overshoot and ringing; with sine frequency response <.5DB down at 3MHz.

12. Check all ranges for correct frequency.

13. Set Range to 1Hz, Multiplier to 0.1. Adjust 0.1Hz symmetry for time symmetry ± 1%.

14. Set Multiplier to S.X, Range to 100KHz. Set search dial max CCW S.O. adjust SEARCH RANGE ADJUST for 100Hz ±5%.

15. Adjust SEARCH SYMMETRY ADJUST for time symmetry ± 2%.

16. Apply +5 D.C. ± 5MV to VCF input. Insure that frequency increases to at least 100KHz.

17. Check output attenuator for proper attenuation.

# SECTION 6

# PARTS LIST

# CODE LIST OF MANUFACTURERS

| Code No. | Manufacturer | Address |
|---|---|---|
| 00000 | U.S.A. Common | Any supplier of U.S. |
| 00136 | McCoy Electronics | Mount Holly Sprgs, Pa. |
| 00213 | Sage Electronics Corp. | Rochester, N.Y. |
| 00334 | Humidpil Co. | Colton, Calif. |
| 00335 | Westrex Corp. | New York, N.Y. |
| 00373 | Garlock Packing Co., Electronic Prod. Div. | Camden, N.J. |
| 00656 | Aerovox Corp. | New Bedford, Mass. |
| 00779 | Amp, Inc | Harrisburg, Pa. |
| 00781 | Aircraft Radio Corp. | Boonton, N.J. |
| 00815 | Northern Eng. Labs, Inc. | Burlington, Wis. |
| 00853 | Sangamo Electric Co. Ordill Div. (Copa) | Marion, Illinois |
| 00866 | Gae Engineering Co. | Los Angeles, Calif. |
| 00891 | Carl E. Holmes Corp. | Los Angeles, Calif. |
| 01121 | Allen Bradley Co. | Milwaukee, Wis |
| 01255 | Litton Industries, Inc. | Beverly Hills, Calif. |
| 01281 | TRW Semiconductors Inc. | Lawndale, Calif. |
| 01295 | Texas Instruments, Inc. Transistor Prod. Div. | Dallas, Texas |
| 01349 | The Alliance Mfg. Co. | Alliance, Ohio |
| 01561 | Chassi-Trak Corp. | Indianapolis, Inc. |
| 01589 | Pacific Relays, Inc. | Van Nuys, Calif. |
| 01930 | Amerock Corp. | Rockford, Illinois |
| 01961 | Pulse Engineering Co. | Santa Clara, Calif. |
| 02114 | Ferroxcube Corp/Amer. | Saugerties, N.Y. |
| 02286 | Cole Mfg. Co. | Palo Alto, Calif. |
| 02660 | Amphenol-Borg El. Corp. | Chicago, Illinois |
| 02735 | Radio Corp. of America, Semiconductor and Materials Div. | Somerville, N.J. |
| 02771 | Vocaline Company of America, Inc. | Old Saybrook, Conn. |
| 02777 | Hopkins Engineering Co. | San Fernando, Calif. |
| 03508 | G.E. Semiconductor Products Dept. | Syracuse, N.Y. |
| 03705 | Apex Machine and Tool Co. | Dayton, Ohio |
| 03797 | Eldema Corp. | El Monte, Calif. |
| 03877 | Transitron Electronic Corp. | Wakefie d, Mass. |
| 03888 | Pyrofilm Resistor Co. | Morristown, N.J. |
| 03954 | Air Marine Motors, Inc. | Los Angeles, Calif. |
| 04009 | Arrow, Hart and Hegemon Electric Co. | Hartford, Conn. |
| 04013 | Taurus Corp. | Lambertville, N.J. |
| 04062 | Elmenco Products Co. | New York, N.Y. |
| 04279 | Hi-Q Division of Aerovox | Myrtle Beach, S.C. |
| 04298 | Elgin National Watch Co. Electronics Div. | Burbank, Calif. |
| 04354 | Precision Paper Tube Co. | Chicago, Illinois |
| 04404 | Dymec Division of Hewlett-Packard Co. | Palo Alto, Calif. |
| 04651 | Sylvania Electric Prod., Inc. Electronic Tube Div. | Mountain View, Calif. |
| 04713 | Motorola/Semicon. Prod. | Phoenix, Arizona |
| 04732 | Fitron Co/Western Div. | Culver City, Calif. |
| 04773 | Automatic Electric Co. | Northlake, Illinois |
| 04777 | Automatic Elect. Sales Corp. | Northlake, Illinois |
| 04796 | Sequoia Wire/Cable Co. | Redwood City, Calif. |
| 04811 | Precision Coil Spring Co. | El Monte, Calif. |
| 04870 | P.M. Motor Co | Chicago, Illinois |
| 05006 | 20th Century Plastics | Los Angeles, Calif. |
| 05277 | Westinghouse/Semicon Dept. | Youngwood, Pa. |
| 05347 | Ultronix, Inc. | San Mateo, Calif. |
| 05393 | Illumitronic Eng. Co. | Sunnyvale, Calif. |
| 05616 | Cosmo Plastic (c/o Electrical Spec. Co.) | Cleveland, Ohio |
| 05624 | Barber Colman Co. | Rockford, Illinois |
| 05728 | Tiffen Optical Co. | Roslyn Heights, L.I., N.Y. |
| 05779 | Metropolitan Telecomm. Corp Metro Cap Div. | Brooklyn, N.Y. |
| 05783 | Stewart Engineering Co. | Santa Cruz, Calif. |
| 05820 | Wakefield Engineering Inc. | Wakefield, Mass. |
| 06104 | The Bassick Co. | Bridgeport, Conn. |
| 06115 | Bausch and Lomb Optical | Rochester, N.Y. |
| 06402 | E.T.A. Products/Amer. | Chicago, Illinois |
| 06475 | Western Devices, Inc. | Inglewood, Calif. |
| 06540 | Amatom Elect. Hardware Co. | New Rochelle, N.Y. |
| 06555 | Beede Electrical Instr Co. | Penacook, N.H. |
| 06751 | U.S. Semicon Div. of Nuclear Corp/Amer. | Phoenix, Ariz. |
| 06812 | Torrington Mfg Co, West Lav. | Van Nuys, Calif |
| 06983 | Kelvin Electric Co | Van Nuys, Calif. |
| 07 55 | Corning Glass Works Electronics Comp. Dept. | Bradford, Pa. |
| 07126 | Digitran Co. | Pasadena, Calif. |
| 07131 | Transistor Electronics Corp. | Minneapolis, Minn. |
| 07138 | Westinghouse Electric Corp Electronic Tube Div. | Elmira, N.Y. |
| 07149 | Filmohm Corp. | New York, N.Y. |
| 07233 | Cinch-Graphik Co. | City of industry, Calif. |
| 07245 | Avnet Corp. | Los Angeles, Calif |
| 07262 | Fairchild Semiconductor Corp. | Mountain View, Calif. |
| 07327 | Minnesota Rubber Co. | Minneapolis, Minn. |
| 07387 | The Birtcher Corp. | Los Angeles, Calif. |
| 07730 | Technical Wire Products | Springfield, N.J. |
| 07910 | Continental Device Corp. | Hawthorne, Calif. |
| 07933 | Rheem Semiconductor Corp. | Mountain View, Calif. |
| 07966 | Shockley Semi-Conductor Labs | Palo Alto, Calif. |
| 07981 | Boonton Radio Corp. | Boonton, N.J. |
| 08145 | U.S. Engineering Co. | Los Angeles, Calif. |
| 08280 | Blinn, Delbert C | Pomona, Calif. |
| 08317 | Burgess Battery Co. | Niagara Falls, Ontario |
| 08717 | Sloan Company | Burbank, Calif |
| 08718 | Cannon Elect Co., Phoenix Div | Phoenix, Ariz. |
| 08792 | CBS Elect. Semiconductor Oper., Div. C.B.S., Inc. | Waterbury, Conn. |
| 08984 | Mel-Rain | Lawrence, Mass. |
| 09026 | Babcock Relays, Inc. | Costa Mesa, Calif. |
| 09134 | Texas Capacitor Co. | Houston, Texas |
| 09145 | Atomic Electronics | Sun Valley, Calif. |
| 09250 | Electro Assemblies, Inc. | Chicago, Illinois |
| 09569 | Mallory Battery Co/Canada Ltd. | Toronto, Ontario, Canada |
| 09664 | The Bristol Company | Waterbury, Conn. |
| 10214 | Gen. Trans. Western Corp. | Los Angeles, Calif |
| 10411 | Ti-Tal, Inc. | Berkeley, Calif. |
| 10597 | Exact Electronics, Inc | Hillsboro, Oreg. |
| 10646 | Carborundum Co. | Niagara Falls, N.Y. |
| 11236 | CTS of Berne, Inc. | Berne, Ind. |
| 11237 | Chicago Tel. of Calif., Inc. | S. Pasadena, Calif. |
| 11312 | Microwave Elect. Corp. | Palo Alto, Calif. |
| 11534 | Duncan Electronics, Inc. | Santa Ana, Calif. |
| 11711 | Gen'l Inst/Semiconductor Div | Newark, N.J. |
| 11717 | Imperial Electronic, Inc. | Buena Park, Calif. |

| Code No. | Manufacturer | Address |
|---|---|---|
| 11870 | Melabs, Inc. | Palo Alto, Calif. |
| 12136 | Philadelphia Handle Co. | Camden, N.J. |
| 12697 | Clarostat Mfg. Co. | Dover, N.H. |
| 12859 | Nippon Elect. Co., Ltd. | Tokyo, Japan |
| 12930 | Delta Semiconductor Inc. | Newport Beach, Calif. |
| 13103 | Thermalloy | Dallas, Texas |
| 13396 | Te-lefunken (G.M.B.H.) | Honnover, Germany |
| 13835 | Midland Mfg. Co. | Kansas City, Kansas |
| 14099 | Sem-Tech | Newbury Park, Calif. |
| 14193 | Calif. Resistor Corp. | Santa Monica, Calif. |
| 14298 | American Components Inc. | Conshahocken, Pa. |
| 14655 | Cornell Dubilier El. Corp. | So. Plainfield, N.J. |
| 14936 | Williams Mfg. Co. | San Jose, Calif. |
| 15203 | Webster Elect., Co., Inc. | Brooklyn, N.Y. |
| 15291 | Adjustable Bushing Co. | N. Hollywood, Calif. |
| 15772 | Twentieth Century Coil Spring Co. | Santa Clara, Calif. |
| 15909 | The Daven Co. | Livingston, N.J. |
| 16037 | Spruce Pine Mica Co. | Spruce Pine, N.C. |
| 16352 | Computer Diode Corp. | Lodi, N.J. |
| 16688 | De Jur-Amsco Corp. | Long Island City, N.Y. |
| 16758 | Delco Radio, Division of G.M. Corp. | Kokomo, Ind. |
| 17109 | Thermonetics, Inc. | Canoga Park, Calif. |
| 17474 | Tranex Company | Mountain View, Calif. |
| 18486 | Radio Industries | Des Plaines, Illinois |
| 18583 | Curtis Instrument, Inc. | Mt. Kisco, N.Y. |
| 18873 | E.I. Dupont and Co., Inc. | Wilmington, Del. |
| 19315 | Eclipse Pioneer, Div. of Bendix Aviation Corp. | Teterboro, N.J. |
| 19500 | Thomas A. Edison Industries Div. McGraw-Edison Co. | West Orange, N.J. |
| 19701 | Electra Manufacturing Co. | Kansas City, Mo. |
| 20183 | Electronic Tube Corp. | Philadelphia, Pa. |
| 21226 | Executive, Inc. | New York, N.Y. |
| 21520 | Fansteel Metallurgical Corp. | No. Chicago, Illinois |
| 21335 | The Fafnir Bearing Co. | New Britain, Conn. |
| 21964 | Fed. Telephone and Radio Corp. | Clifton, N.J. |
| 24446 | General Electric Co. | Schenectady, N.Y. |
| 24455 | G.E. Lamp Div. | Nela Park, Cleveland, Ohio |
| 24655 | General Radio Co. | W. Concord, Mass. |
| 26365 | Gries Reproducer Corp. | New Rochelle, N.Y. |
| 26462 | Grobet File Co/America, Inc. | Carlstadt, N.J. |
| 26992 | Hamilton Watch Co. | Lancaster, Pa. |
| 28480 | Hewlett-Packard Co. | Palo Alto, Calif. |
| 33173 | Myrtle Beach, S.C. | Owensboro, Ky. |
| 35434 | Jectrahm, Inc. | Chicago, Ill. |
| 36196 | Stanwyck Corp. | Hawkesburn, Ontario, Cd. |
| 37942 | P.R. Mallory and Co., Inc. | Indianapolis, Ind. |
| 39543 | Mechanical Industries Prod. | Akron, Ohio |
| 40920 | Miniature Precision Bearings | Keene, N.H. |
| 42-90 | Muter Co. | Chicago, Illinois |
| 43990 | C.A. Norgren Co. | Englewood, Colo. |
| 44655 | Ohmite Mfg. Co. | Skokie, Illinois |
| 47904 | Pa prold Corp. | Cambridge, Mass. |
| 48620 | Precision Thermometer/Inst. | Philadelphia, Pa. |
| 49956 | Raytheon Company | Lexington, Mass. |
| 52090 | Rowan Controller Co. | Baltimore, Md. |
| 53743 | Word Leonard Electric | Mt. Vernon, N.Y. |
| 54294 | Shallcross Mfg. Co. | Selma, N.C. |
| 55026 | Simpson Electric Co. | Chicago, Illinois |
| 55933 | Sonotone Corp. | Elmsford, N.Y. |
| 55938 | Sorenson and Co., Inc. | S. Norwalk, Conn. |
| 56137 | Spaulding Fibre Co., Inc. | Tonowanda, N.Y. |
| 56289 | Sprague Electric Co. | N. Adams, Mass. |
| 59446 | Telex, Inc. | St. Paul, Minn. |
| 59730 | Thomas and Betts Co. | Elizabeth, N.J. |
| 60741 | Tripplett Electrical Inc. | Bluffton, Ohio |
| 61775 | Union Switch and Signal, Div. Westinghouse Air Brake Co. | Swissvale, Pa. |
| 62119 | Universal Electric Co. | Ossoso, Mich. |
| 63743 | Ward-Leonard Electric Co. | Mt. Vernon, N.Y. |
| 64959 | Western Electric Co., Inc. | New York, N.Y. |
| 65092 | West Inst. Div. Daystrom | Newark, N.J. |
| 66295 | Wittek Manufacturing Co. | Chicago, Illinois |
| 66346 | Wollensak Optical Co. | Rochester, N.Y. |
| 70226 | Allen Manufacturing Co. | Hartford, Conn. |
| 71030 | Allied Control Co., Inc. | New York, N.Y. |
| 71984 | Allmetal Screw Prod. Co, Inc. | Garden City, N.Y. |
| 72065 | Atlantic India Rubber Works | Chicago, Illinois |
| 72136 | Amperite Co., Inc. | New York, N.Y. |
| 72259 | Belden Manufacturing Co. | Chicago, Illinois |
| 72699 | Bird Electronic Corp. | Cleveland, Ohio |
| 73002 | Birnbach Radio Co. | New York, N.Y. |
| 73041 | Boston Gear Works Div. of Murray Co. of Texas | Quincy, Mass. |
| 712 8 | Bud Radio Inc. | Cleveland, Ohio |
| 71286 | Camloc Fastener Corp. | Paramus, N.J. |
| 71313 | Allen D. Cardwell Elect. Prod. Corp. | Plainville, Conn. |
| 71400 | Bussmann Fuse Div. of McGraw-Edison Co. | St. Louis, Mo. |
| 71436 | Chicago Condenser Corp. | Chicago, Illinois |
| 71450 | CTS Corp. | Elkhart, Ind. |
| 71468 | Cannon Electric Co. | Los Angeles, Calif. |
| 71471 | Cinema Engineering Co. | Burbank, Calif |
| 71482 | C.P. Clare and Co. | Chicago, Illinois |
| 71590 | Centralab, Div. Globe Union, Inc. | Milwaukee, Wis. |
| 71616 | Commercial Plastics Co. | Chicago, Illinois |
| 71700 | The Cornish Wire Co | New York, N.Y. |
| 71744 | Chicago Miniature Lamp Wks | Chicago, Illinois |
| 71753 | A. O. Smith Corp. Crowley Div. | West Orange, N.J. |
| 71785 | Cinch Mfg. Corp. | Chicago, Illinois |
| 71828 | Dow Corning Corp. | Midland, Mich. |
| 72092 | Eitel-McCullough, Inc. | San Bruno, Calif. |
| 72136 | Electro Motive Mfg. Co, Inc. | Willimantic, Conn. |
| 71707 | Coto Coil, Co., Inc. | Providence, R.I. |
| 72293 | John E Fast and Company | Chicago, Illinois |
| 72619 | Dietight Corp. | Brooklyn, N.Y. |
| 72656 | General Ceramics Corp. | Keasbey, N.J. |
| 72699 | General Instrument Corp. Semiconductor Div. | Newark, N.J. |
| 72758 | Girard-Hopkins | Oakland, Calif. |
| 72765 | Drake Mfg. Co. | Chicago, Illinois |
| 72825 | Hugh H. Eby, Inc. | Philadelphia, Pa. |
| 72928 | Gudeman Co. | Chicago, Illinois |
| 72965 | Robert M. Hadley Co. | Los Angeles, Calif. |
| 72982 | Erie Resistor Corp. | Erie, Pa. |
| 73061 | Hansen Mfg. Co., Inc. | Princeton, Ind. |
| 73076 | H. M. Harper Co. | Chicago, Illinois |
| 73138 | Helipat, Div. Beckman Instruments, Inc. | Fullerton, Calif. |

| Code No. | Manufacturer | Address |
|---|---|---|
| 73293 | Hughes Products Div. of Hughes Aircraft Co. | Newport Beach, Calif. |
| 73445 | Amperex Electronic Co., Div. No. American Phillips Co., Inc. | Hicksville, N.Y. |
| 73490 | Beckman Helipot Corp. | S. Pasadena, Calif. |
| 73506 | Bradley Semiconductor Corp. | Hamden, Conn. |
| 73559 | Carling Electric, Inc. | Hartford, Conn. |
| 73682 | George K. Garrett Co., Inc. | Philadelphia, Pa. |
| 73734 | Federal Screw Prod. Co. | Chicago, Illinois |
| 73743 | Fischer Special Mfg. Co. | Cincinnati, Ohio |
| 73793 | The General Industries Co. | Elyria, Ohio |
| 73846 | Goshen Stamping and Tool | Goshen, Ind. |
| 73899 | JFD Electronics Corp. | Brooklyn, N.Y. |
| 73905 | Jennings Radio Mfg. Co. | San Jose, Calif. |
| 74276 | Signalite, Inc. | Neptune, N.J. |
| 74455 | J. H. Winns and Sons | Winchester, Mass. |
| 7486 | Industrial Condenser Corp. | Chicago, Illinois |
| 74868 | R.F. Prod. Div. of Amphenol-Borg Electronics Corp. | Danbury, Conn. |
| 74970 | E.F. Johnson Co. | Waseca, Minn. |
| 75042 | International Resistance Co. | Phi.adelphia, Pa. |
| 75173 | Jones, Howard B., Div. of Cinch Mfg. Corp. | Chicago, Illinois |
| 75378 | James Knights Co. | Sandwich, Illinois |
| 75382 | Kulka Electric Corp. | Mt. Vernon, N.Y. |
| 75818 | Lanz Electric Mfg. Co. | Chicago, Illinois |
| 75915 | Littlefuse, Inc. | Des Plaines, Illinois |
| 76005 | Lord Mfg. Co. | Erie, Pa. |
| 76210 | C.W. Marwedel | San Francisco, Calif. |
| 76433 | Micamold Electronic Mfg. Corp | Brooklyn, N.Y. |
| 76487 | James Millen Mfg. Co., Inc. | Malden, Mass. |
| 76493 | J.W. Miller Co. | Los Angeles, Calif. |
| 76530 | Monadnock Mills | San Leandro, Calif. |
| 76545 | Mueller Electric Co. | Cleveland, Ohio |
| 76854 | Oak Manufacturing Co. | Crystal Lake, Illinois |
| 77068 | Bendix Pacific Div. of Bendix Corp. | N. Hollywood, Calif. |
| 77075 | Pacific Metals Co. | San Francisco, Calif. |
| 77221 | Phaostron Instrument and Electronic Co. | S. Pasadena, Calif. |
| 77250 | Pnaell Manufacturing Co. | Chicago, Illinois |
| 77252 | Philadelphia Steel and Wire Corporation | Philadelphia, Pa. |
| 77342 | Potter and Brumfield, Div. of American Machine/Foundry | Princeton, Ind. |
| 77630 | Radio Condenser Co. | Camden, N.J. |
| 77638 | Radio Receptor Co., Inc. | Brooklyn, N.Y. |
| 77764 | Resistance Products Co. | Harrisburg, Pa. |
| 77969 | Rubbercraft Corp. of Calif. | Torrance, Calif. |
| 78189 | Shakeproof, Div. of Illinois Tool Works | Elgin, Illinois |
| 78283 | Signal Indicator Corp. | New York, N.Y. |
| 78290 | Struthers-Dunn, Inc. | Pitman, N.J. |
| 78452 | Thompson-Bremer and Co. | Chicago, Illinois |
| 78471 | Tilley Manufacturing Co. | San Francisco, Calif. |
| 78488 | Stackpole Carbon Co. | St. Marys, Pa. |
| 78493 | Standard Thomson Corp. | Waltham, Mass. |
| 78553 | Tinnerman Products, Inc. | Cleveland, Ohio |
| 78790 | Transformer Engineers | Pasadena, Calif. |
| 78947 | Ucinite Co. | Newtonville, Mass. |
| 79 42 | Vessar Tool, Inc. | Hartford, Conn. |
| 79251 | Wenco Mfg. Co. | Chicago, Illinois |
| 79727 | Continental-Wirt Elect. Corp. | Philadelphia, Pa. |
| 79963 | Zierick Mfg. Corp. | New Rochelle, N.Y. |
| 8003. | Mepco, Div. of Sessions Clock Company | Morristown, N.J. |
| 80120 | Schnitzer Alloy Products | Elizabeth, N.J. |
| 80130 | Times Facsimile Corp. | New York, N.Y. |
| 80131 | E.ectronic Industries Assoc. Any brand tube meeting EIA standards. | Washington D.C. |
| 80207 | Unimax Switch, Div. of W L Maxson Corp. | Wallingford, Conn. |
| 80223 | United Transformer Corp. | New York, N.Y. |
| 80248 | Oxford Electric Corp. | Chicago, Illinois |
| 80294 | Bourns Laboratories, Inc. | Riverside, Calif. |
| 80411 | Acro, Div. Robershaw Fulton Controls Co. | Columbus, Ohio Columbus, Ohio |
| 80486 | All Star Products, Inc. | Defiance, Ohio |
| 80509 | Avery Adhesive Label Corp. | Monrovia, Calif. |
| 80583 | Hammarlund Co., Inc. | New York, N.Y. |
| 80640 | Stevens, Arnold Co., Inc. | Boston, Mass. |
| 81030 | International Instruments, Inc. | New Haven, Conn. |
| 81073 | Graybill Co. | LaGrange, Illinois |
| 81095 | Triad Transformer Corp. | Venice, Calif. |
| 81312 | Winchester Electronics Co, | Norwalk, Conn. |
| 81349 | Military Specifications | - - - |
| 81415 | Wilkor Products, Inc. | Cleveland, Ohio |
| 81453 | Raytheon Mfg. Co., Industrial Components Div, Industrial Tube Oper. | Newton, Mass. |
| 81483 | International Rectifier Corp. | El Segundo, Calif. |
| 81541 | The Airpax Products Co. | Cambridge, Mass. |
| 81860 | Barry Controls, Inc. | Watertown, Mass. |
| 82042 | Carter Parts Co. | Skokie, Illinois |
| 82142 | Jeffers Electronics, Div. of Speer Carbon Co. | DuBois, Pa. |
| 82170 | Allen B. DuMont Labs, Inc. | Clifton, N.J. |
| 82209 | Maguire Industries, Inc. | Greenwich, Conn. |
| 82219 | Sylvania Electric Prod., Electronic Tube Div. | Emporium, Pa. |
| 82376 | Astron Company | E. Newark, N.J. |
| 82389 | Switchcraft, Inc. | Orange, Illinois |
| 82647 | Metals and Controls, Inc., Div. Texas Instruments, Spencer Products | Attleboro, Mass. |
| 82866 | Research Products Corp. | Madison, Wisc. |
| 82877 | Rotron Mfg. Co., Inc. | Woodstock, N.Y. |
| 82893 | Vector Electronic Co. | Glendale, Calif. |
| 83053 | Weston Electrical Mfr. Co. | Los Angeles, California |
| 83058 | Corr Fastener Co. | Cambridge, Mass. |
| 83086 | New Hampshire Ball Bearing | Peterborough, N.H. |
| 83125 | Pyramid Electric Co. | Darlington, S.C. |
| 83148 | Electro Cords Co. | Los Angeles, Calif. |
| 83186 | Victory Engineering Corp. | Springfield, N.J. |
| 83298 | Bendix Corp/Red Bank Div. | Red Bank, N.J. |
| 833:5 | Hubbell Corp. | Munalein, Illinois |
| 83530 | Smith, Herman H., Inc. | Brooklyn, N.Y. |
| 83585 | Central Screw Co. | Chicago, Illinois |
| 83501 | Gavitt Wire and Cable Co., Div. Amerace Corp. | Brookfield, Mass. |
| 83594 | Burroughs Corp., Electronic Tube Div. | Plainfield, N.J. |

| Code No. | Manufacturer | Address |
|---|---|---|
| 83740 | Eveready Battery | New York, N.Y. |
| 83777 | Model Eng. and Mfg., Inc. | Huntington, Ind. |
| 83821 | Loyd Scruggs Co. | Festus, Mo. |
| 84171 | Arco Electronics, Inc. | New York, N.Y. |
| 84396 | A.J. Glesener Co., Inc. | San Francisco, Calif. |
| 84411 | Good All Electric Mfg. Co. | Ogal alla, Neb. |
| 84970 | Sarkes Tarzian, Inc. | Bloomington, Ind. |
| 85454 | Boonton Molding Co. | Boonton, N.J. |
| 85474 | R.M. Bracamonte and Co. | San Francisco, Calif. |
| 85660 | Koiled Kords, Inc. | New Haven, Conn. |
| 85911 | Seamless Rubber Co. | Chicago, Illinois |
| 86197 | Clifton Precision Products | Clifton Heights, Pa. |
| 86579 | Precision Rubber Products Corp. | Dayton, Ohio |
| 86684 | Radio Corp. of America, RCA Electron Tube Div. | Harrison, N.J. |
| 87216 | Philco Corp. (Lansing Div.) | Lansing, Pa. |
| 87473 | Western Fibrous Glass Products Co. | San Francisco |
| 87664 | Van Waters and Rogers, Inc. | Seattle, Wash. |
| 87930 | Tower Mfg. Co. | Providence, R.I. |
| 88140 | Cutler-Hammer, Inc. | Lincoln, Illinois |
| 88220 | Gould-National Batteries, Inc. | St. Paul, Minn. |
| 88698 | General Mills, Inc. | Buffalo, N.Y. |
| 89231 | Graybar Electric Co. | Oakland, Calif. |
| 89462 | Wales Kahinoor, Inc. | Cambridge, Mass. |
| 89473 | General Electric Distributing Corp. | Schenectady, N.Y. |
| 89636 | Carter Parts Div. of Economy Baker Co. | Chicago, Illinois |
| 89665 | United Transformer Co. | Chicago, Illinois |
| 90179 | U.S. Rubber Co., Mechanical Goods Div. | Passaic, N.J. |
| 90970 | Bearing Engineering Co. | San Francisco, Calif. |
| 9 260 | Connor Spring Mfg. Co. | San Francisco, Calif. |
| 91345 | Miller Dial and Nameplate Co. | El Monte, Calif. |
| 91418 | Radio Materials Co. | Chicago, Illinois |
| 91506 | Augat Brothers', Inc. | Attleboro, Mass. |
| 91637 | Dale Electronics, Inc. | Columbus, Neb. |
| 91662 | Elco Corp. | Philadelphia |
| 91737 | Grenoe Mfg Co., Inc. | Wakefield, Mass. |
| 91929 | Minneapolis-Honeywell Regulator Co., Microswitch Div. | Freeport, Illinois |
| 91961 | Nahm-Bros. Spring Co. | Oakland, Calif. |
| 92180 | Tru-Connector Corp. | Peabody, Mass. |
| 92196 | Universal Metal Prod., Inc. | Bassett Purite, Calif. |
| 92367 | Elgeet Optical Co., Inc. | Rochester, N.Y. |
| 92607 | Tinsolite Insulated Wire Co. | Tarrytown, N.Y. |
| 93337 | Sylvania Electric Prod, Inc. Semiconductor Div. | Waburn, Mass. |
| 93369 | Robbins and Myers, Inc. | New York, N.Y. |
| 93610 | Stevens Mfg. Co., Inc. | Mansfield, Ohio |
| 93788 | Howard J. Smith, Inc. | Port Monmouth, N J |
| 93929 | G.V. Controls | Livingston, N.J. |
| 93983 | Insuline-Van Norman Ind., Inc. Electronic Division | Manchester, N.H. |
| 94137 | General Cable Corp. | Bayonne, N.J. |
| 94144 | Raytheon Mfg. Co., Industrial Comp. Div, Rec. Tube Div. | Quincy, Mass. |
| 94145 | Raytheon Mfg. Co., Semiconductor Div, Calif. St. Plt | Newton, Mass. |
| 94148 | Scientif'c Radio Products | Loveland, Colo. |
| 94154 | Tung-Sol Electric, Inc. | Newark, N.J. |
| 94197 | Curtiss-Wright Corp. Electronics Div. | E. Paterson, N.J. |
| 94222 | Southco, Div. S. Chester Corp. | Lester, Pa. |
| 943 0 | Tru Ohm Prod., Div. Model Engineering and Mfg. Co. | Chicago, Illinois |
| 94330 | Wire Cloth Products, Inc. | Chicago, Illinois |
| 94682 | Worcester Pressed Alum. Corp. | Worcester, Mass. |
| 95023 | Philbrick Researchers, Inc. | Boston, Mass. |
| 95236 | Allies Products Corp. | Miami, Fla. |
| 95238 | Continental Connector Corp. | Woodside, N.Y. |
| 95263 | Leecraft Mfg. Co., Inc. | New Yorx, N.Y. |
| 95264 | Lerco Electronics, Inc. | Burbank, Calif. |
| 95265 | National Coil Co. | Sheridan, Wyo. |
| 95275 | Vitramon, Inc. | Bridgeport, Conn. |
| 95348 | Gordos Corp. | Bloomfield, N.J. |
| 95354 | Methode Mfg. Co. | Chicago, Illinois |
| 95712 | Dage Electric Co., Inc. | Franklin, Ind. |
| 95987 | Weckesser Co. | Chicago, Illinois |
| 96067 | Huggins Laboratories | Sunnyvale, Calif. |
| 96095 | Hi-Q Div. of Aerovox | Olean, N.Y. |
| 96756 | Thordarson-Meissner, Div. Maguire Industries, Inc. | Mt. Carmel, Ill. |
| 96296 | Solar Manufacturing Co. | Los Angeles, Calif. |
| 96330 | Carlton Screw Co. | Chicago, Illinois |
| 96341 | Microwave Associates, Inc. | Burlington, Mass. |
| 96501 | Excel Transformer Co. | Oakland, Calif. |
| 97464 | Industrial Retaining Ring Co. | Irvington, N.J |
| 97539 | Automatic and Precision Mfg. | Yonkers, N.Y. |
| 97966 | CBS Electronics Div. C.B.S., Inc. | Danvers, Mass. |
| 97979 | Rear Resistor Corp. | Yonkers, N.Y. |
| 98141 | Axel Brothers, Inc. | Jamaica, N.Y. |
| 98159 | Rubber Teck, Inc. | Gardena, Calif. |
| 98220 | Francis L. Mosley | Pasadena, Calif. |
| 98278 | Microdot, Inc. | S. Pasadena, Calif. |
| 98291 | Sealectro Corp. | Mamaroneck, N.Y. |
| 98405 | Carad Corp. | Redwood City, Calif. |
| 98731 | General Mills | Minneapolis, Minn. |
| 9887 | North Hills Electric Co. | Mineola, N.Y. |
| 98925 | Clevite Transistor Prod. Div. Clevite Corp. | Waltham, Mass. |
| 98978 | International Electronic Research Corp. | Burbank, Calif. |
| 99109 | Columbia Technical Corp. | New York, N.Y. |
| 99313 | Varian Associates | Palo Alto, Calif. |
| 99515 | Marshall Industries, Electran Products Division | Pasadena, Calif. |
| 99707 | Control Switch Div, Controls Co. of America | El Segundo, Calif |
| 99800 | Delevan Electronics Corp. | E. Aurora, N.Y. |
| 99848 | Wilco Corporation | Indianapolis, Ind. |
| 99934 | Renbrandt, Inc. | Boston, Mass. |
| 99942 | Hoffman Semiconductor Div. of Hoffman Electronics Corp. | Evanston, Illinois |
| 99957 | Technology Instrument Corp. of California | Newbury Park, Calif. |

| PART | DESCRIPTION | EXACT NO | MFG |
|---|---|---|---|
| B001 | PILOT LIGHT | 1360045 | 100005 |
| C001 | CAPACITOR, 2000MFD 25V | 2900032 | 14655 |
| C002 | CAPACITOR, 2000MFD 25V | 2900032 | 14655 |
| C003 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C010 | CAPACITOR, 470PF MICA | 2810539 | 853 |
| C013 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C040 | CAPACITOR, 5000 PF DISCAP | 2830011 | 91418 |
| C041 | CAPACITOR, 220PF MICA | 2810555 | 853 |
| C042 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C043 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C060 | CAPACITOR, 6.8 MFD 35 VOLT | 2900043 | 100002 |
| C061 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C100 | CAPACITOR, 6.8 MFD 35 VOLT | 2900043 | 100002 |
| C101 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C102 | CAPACITOR, 6.8 MFD 35 VOLT | 2900043 | 100002 |
| C103 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C121 | CAPACITOR, 150PF MICA | 2810557 | 853 |
| C170 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C190 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C200 | CAPACITOR, 470PF MICA | 2810539 | 853 |
| C210 | CAPACITOR, 3-12PF TRIM | 2810036 | 72982 |
| C230 | CAPACITOR, 6.8 MFD 35 VOLT | 2900043 | 100002 |
| C231 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C250 | CAPACITOR, 6.8 MFD 35 VOLT | 2900043 | 100002 |
| C251 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C253 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C260 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C270 | CAPACITOR, 390PF MICA | 2810556 | 853 |
| C320 | CAPACITOR, 5000 PF DISCAP | 2830011 | 91418 |
| C321 | CAPACITOR, 220PF MICA | 2810555 | 853 |
| C322 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C323 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C330 | CAPACITOR, 5000 PF DISCAP | 2830011 | 91418 |
| C331 | CAPACITOR, 220PF MICA | 2810555 | 853 |
| C332 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C333 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C334 | CAPACITOR, 6.8 MFD 35 VOLT | 2900043 | 100002 |
| C360 | CAPACITOR, 5000 PF DISCAP | 2830011 | 91418 |
| C361 | CAPACITOR, 220PF MICA | 2810555 | 853 |
| C362 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C380 | CAPACITOR, 220PF MICA | 2810555 | 853 |
| C381 | CAPACITOR, 5000 PF DISCAP | 2830011 | 91418 |
| C382 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C401 | CAPACITOR, TIMING SET | 2950003 | 10597 |
| C403 | CAPACITOR, 270PF MICA | 2810540 | 853 |
| C404 | CAPACITOR, 8-50PF TRIM | 2810022 | 72982 |
| C406 | CAPACITOR, 8PF MICA | 2810535 | 853 |
| C430 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C431 | CAPACITOR, 47PF MICA | 2810532 | 853 |
| C432 | CAPACITOR, 8-50PF TRIM | 2810022 | 72982 |
| C433 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C434 | CAPACITOR, 6.8 MFD 35 VOLT | 2900043 | 100002 |
| C491 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C500 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C531 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| C540 | CAPACITOR, 0.05 UF DISCAP | 2830010 | 91418 |
| D001 | RECTIFIER BRIDGE, MDA920A | 1520920 | 4713 |
| D050 | DIODE, 1N756 | 1520756 | 1295 |
| D100 | DIODES, MATCHED SET FD777 | 1530777 | 10597 |
| D104 | DIODES, MATCHED SET FD777 | 1530777 | 10597 |
| D108 | DIODES, MATCHED SET FD777 | 1530777 | 10597 |
| D170 | DIODE, 1N914 | 1520914 | 7910 |
| D180 | DIODE, 1N914 | 1520914 | 7910 |
| D250 | DIODE, 1N914 | 1520914 | 7910 |
| D260 | DIODE, 1N914 | 1520914 | 7910 |
| D370 | DIODES, MATCHED SET FD777 | 1530777 | 10597 |
| D451 | DIODE, 1N914 | 1520914 | 7910 |
| D452 | DIODE, 1N914 | 1520914 | 7910 |
| D460 | DIODE, 1N914 | 1520914 | 7910 |
| D461 | DIODE, 1N914 | 1520914 | 7910 |
| D462 | DIODE, 1N914 | 1520914 | 7910 |
| D463 | DIODE, 1N914 | 1520914 | 7910 |
| D470 | DIODE, 1N914 | 1520914 | 7910 |
| D530 | DIODE, 1N914 | 1520914 | 7910 |
| D531 | DIODE, 1N914 | 1520914 | 7910 |
| D532 | DIODE, 1N914 | 1520914 | 7910 |
| D540 | DIODE, 1N914 | 1520914 | 7910 |
| D541 | DIODE, 1N914 | 1520914 | 7910 |
| D542 | DIODE, 1N914 | 1520914 | 7910 |
| D550 | DIODE, 1N914 | 1520914 | 7910 |
| D551 | DIODE, 1N914 | 1520914 | 7910 |
| D552 | DIODE, 1N914 | 1520914 | 7910 |
| D553 | DIODE, 1N914 | 1520914 | 7910 |
| F001 | FUSE, 3AG 1/4 AMP SLO-BLO | 1590025 | 71400 |
| Q010 | INTEGRATED CIRCUIT, UA723 | 1580012 | 7263 |
| Q020 | TRANSISTOR, 2N4921 | 1564921 | 4713 |
| Q040 | OPERATIONAL AMPLIFIER, UA709 | 1580016 | 7263 |
| Q050 | TRANSISTOR, 2N3638 | 1563638 | 7263 |
| Q060 | TRANSISTOR, 2N4918 | 1564918 | 4713 |
| Q065 | TRANSISTOR, 2N3643 | 1563643 | 4713 |
| Q120 | TRANSISTORS, MATCHED PAIR MPS3646 | 1570008 | 10597 |
| Q140 | TRANSISTOR, 2N3646 | 1563646 | 4713 |
| Q150 | TRANSISTOR, MATCHED 2N4121 | 1574121 | 10597 |
| Q170 | TRANSISTOR, 2N3646 | 1563646 | 4713 |

| PART | DESCRIPTION | EXACT NO | MFG |
|---|---|---|---|
| Q180 | TRANSISTOR, 2N3646 | 1563646 | 4713 |
| Q190 | TRANSISTOR, 2N4121 | 1564121 | 7263 |
| Q200 | TRANSISTORS, MATCHED PAIR MPS3646 | 1570008 | 10597 |
| Q220 | TRANSISTOR, 2N3646 | 1563646 | 4713 |
| Q230 | TRANSISTOR, 2N2905 | 1562905 | 1295 |
| Q240 | TRANSISTOR, 2N2905 | 1562905 | 1295 |
| Q250 | TRANSISTOR, 2N2219 | 1562219 | 1295 |
| Q260 | TRANSISTOR, 2N2905 | 1562905 | 1295 |
| Q320 | OPERATIONAL AMPLIFIER, UA709 | 1580016 | 7263 |
| Q330 | OPERATIONAL AMPLIFIER, UA709 | 1580016 | 7263 |
| Q340 | TRANSISTOR, SELECTED 2N5462 | 1575462 | 10597 |
| Q350 | TRANSISTOR, TO101 | 1580017 | 56289 |
| Q360 | OPERATIONAL AMPLIFIER, UA709 | 1580016 | 7263 |
| Q370 | TRANSISTOR, 2N5462 | 1565462 | 4713 |
| Q380 | OPERATIONAL AMPLIFIER, UA709 | 1580016 | 7263 |
| Q390 | TRANSISTOR, 2N5485 | 1565485 | 4713 |
| Q410 | TRANSISTORS, MATCHED 2N5485 | 1575485 | 10597 |
| Q430 | TRANSISTORS, MATCHED PAIR MPS3646 | 1570008 | 10597 |
| Q450 | TRANSISTORS, MATCHED PAIR MPS3646 | 1570008 | 10597 |
| Q470 | TRANSISTOR, 2N3646 | 1563646 | 4713 |
| Q480 | TRANSISTOR, MPS3640 | 1563640 | 4713 |
| Q490 | TRANSISTOR, MPS3640 | 1563640 | 4713 |
| Q500 | TRANSISTOR, MPS3640 | 1563640 | 4713 |
| Q510 | TRANSISTOR, MPS3640 | 1563640 | 4713 |
| Q520 | TRANSISTOR, 2N3638 | 1563638 | 7263 |
| Q530 | TRANSISTOR, 2N3646 | 1563646 | 4713 |
| Q540 | TRANSISTOR, MPS3640 | 1563640 | 4713 |
| Q550 | TRANSISTOR, 2N4121 | 1564121 | 7263 |
| R001 | RESISTOR, 68K OHM 1/4W 5% CARBON | 3070683 | 1121 |
| R010 | POTENTIOMETER, 500 OHM TRIM | 3110142 | 71450 |
| R012 | RESISTOR, 3240 OHM 1/4W 1% METAL FILM | 3133241 | 7115 |
| R013 | RESISTOR, 2000 OHM 1/4W 1% METAL FILM | 3132001 | 7115 |
| R014 | RESISTOR, 1200 OHM 1/4W 5% CARBON | 3070122 | 1121 |
| R020 | RESISTOR, 2.0 OHM 1/2W 5% CARBON | 3010020 | 1121 |
| R040 | RESISTOR, 10000 OHM 1/4W 1% METAL FILM | 3131002 | 7115 |
| R041 | RESISTOR, 9760 OHM 1/4W 1% METAL FILM | 3139761 | 7115 |
| R042 | POTENTIOMETER, 500 OHM TRIM | 3110142 | 71450 |
| R043 | RESISTOR, 4990 OHM 1/4W 1% METAL FILM | 3134991 | 7115 |
| R044 | RESISTOR, 1500 OHM 1/4W 5% CARBON | 3070152 | 1121 |
| R050 | RESISTOR, 5100 OHM 1/4W 5% CARBON | 3070512 | 1121 |
| R065 | RESISTOR, 1.0 OHM 1/2W 5% CARBON | 3010010 | 1121 |
| R100 | RESISTOR, 499 OHM 1/4W 1% METAL FILM | 3134990 | 7115 |
| R101 | RESISTOR, 54.9 OHM 1/4W 1% METAL FILM | 3130549 | 7115 |
| R102 | RESISTOR, 150 OHM 1/4W 1% METAL FILM | 3131500 | 7115 |
| R103 | RESISTOR, 8450 OHM 1/4W 1% METAL FILM | 3138451 | 7115 |
| R104 | RESISTOR, 8450 OHM 1/4W 1% METAL FILM | 3138451 | 7115 |
| R105 | POTENTIOMETER, 500 OHM TRIM | 3110142 | 71450 |
| R106 | POTENTIOMETER, 500 OHM TRIM | 3110142 | 71450 |
| R107 | POTENTIOMETER, 500 OHM TRIM | 3110142 | 71450 |
| R108 | RESISTOR, 9530 OHM 1/4W 1% METAL FILM | 3139531 | 7115 |
| R109 | RESISTOR, 9530 OHM 1/4W 1% METAL FILM | 3139531 | 7115 |
| R110 | POTENTIOMETER, 500 OHM TRIM | 3110142 | 71450 |
| R111 | RESISTOR, 19100 OHM 1/4W 1% METAL FILM | 3131912 | 7115 |
| R112 | RESISTOR, 19100 OHM 1/4W 1% METAL FILM | 3131912 | 7115 |
| R113 | RESISTOR, 309 OHM 1/4W 1% METAL FILM | 3133090 | 7115 |
| R114 | RESISTOR, 200 OHM 1/8W 1% METAL FILM | 3182000 | 7115 |
| R115 | RESISTOR, 127 OHM 1/4W 1% METAL FILM | 3131270 | 7115 |
| R116 | RESISTOR, 49.9 OHM 1/4W 1% METAL FILM | 3130499 | 7115 |
| R120 | RESISTOR, 1210 OHM 1/4W 1% METAL FILM | 3131211 | 7115 |
| R122 | RESISTOR, 100 OHM 1/4W 5% CARBON | 3070101 | 1121 |
| R130 | RESISTOR, 1210 OHM 1/4W 1% METAL FILM | 3131211 | 7115 |
| R131 | RESISTOR, 20 OHM 1/4W 5% CARBON | 3070200 | 1121 |
| R132 | RESISTOR, 100 OHM 1/4W 5% CARBON | 3070101 | 1121 |
| R133 | POTENTIOMETER, 100K OHM TRIM | 3110143 | 71450 |
| R134 | RESISTOR, 33200 OHM 1/4W 1% METAL FILM | 3133322 | 7115 |
| R135 | RESISTOR, 63.4 OHM 1/4W 1% METAL FILM | 3130634 | 7115 |
| R136 | POTENTIOMETER, 100 OHM TRIM | 3110141 | 71450 |
| R137 | RESISTOR, 442 OHM 1/4W 1% METAL FILM | 3134420 | 7115 |
| R140 | RESISTOR, 4990 OHM 1/4W 1% METAL FILM | 3134991 | 7115 |
| R141 | RESISTOR, 4990 OHM 1/4W 1% METAL FILM | 3134991 | 7115 |
| R142 | RESISTOR, 681 OHM 1/4W 1% METAL FILM | 3136810 | 7115 |
| R150 | RESISTOR, 330 OHM 1/2W 5% CARBON | 3010331 | 1121 |
| R151 | RESISTOR, 39 OHM 1/4W 5% CARBON | 3070390 | 1121 |
| R160 | RESISTOR, 39 OHM 1/4W 5% CARBON | 3070390 | 1121 |
| R161 | RESISTOR, 200 OHM 1/4W 5% CARBON | 3070202 | 1121 |
| R180 | RESISTOR, 4.7 OHM 1/4W 5% CARBON | 3070047 | 1121 |
| R190 | RESISTOR, 4.7 OHM 1/4W 5% CARBON | 3070047 | 1121 |
| R191 | RESISTOR, 3000 OHM 1/4W 5% CARBON | 3070302 | 1121 |
| R200 | RESISTOR, 110 OHM 1/4W 1% METAL FILM | 3131100 | 7115 |
| R201 | RESISTOR, 4.7 OHM 1/4W 5% CARBON | 3070047 | 1121 |
| R202 | CONCENTRIC SWITCH AND POTENTIOMETER | 2600311 | 71450 |
| R203 | RESISTOR, 9.1 OHM 1/2W 5% CARBON | 3010091 | 1121 |
| R204 | RESISTOR, 1.0 OHM 1/2W 5% CARBON | 3010010 | 1121 |
| R205 | RESISTOR, 2000 OHM 1/4W 1% METAL FILM | 3132001 | 7115 |
| R206 | RESISTOR, 100 OHM 1/4W 1% METAL FILM | 3131000 | 7115 |
| R210 | RESISTOR, 2000 OHM 1/4W 1% METAL FILM | 3132001 | 7115 |
| R211 | RESISTOR, 100 OHM 1/4W 5% CARBON | 3070101 | 1121 |
| R212 | RESISTOR, 100 OHM 1/4W 5% CARBON | 3070101 | 1121 |
| R213 | RESISTOR, 976 OHM 1/4W 1% METAL FILM | 3139760 | 7115 |
| R214 | POTENTIOMETER, 100 OHM TRIM | 3110141 | 71450 |
| R215 | RESISTOR, 75.0 OHM 1/4W 1% METAL FILM | 3130750 | 7115 |
| R216 | RESISTOR, 1100 OHM 1/4W 1% METAL FILM | 3131101 | 7115 |
| R217 | RESISTOR, 33200 OHM 1/4W 1% METAL FILM | 3133322 | 7115 |
| R218 | POTENTIOMETER, 100K OHM TRIM | 3110143 | 71450 |

| PART | DESCRIPTION | EXACT NO | MFG |
|---|---|---|---|
| R219 | POTENTIOMETER, 10K OHM WITH SWITCH | 3110333 | 71450 |
| R220 | RESISTOR, 4990 OHM 1/4W 1% METAL FILM | 3134991 | 7115 |
| R221 | RESISTOR, 4990 OHM 1/4W 1% METAL FILM | 3134991 | 7115 |
| R222 | RESISTOR, 1500 OHM 1/4W 1% METAL FILM | 3131501 | 7115 |
| R230 | RESISTOR, 143 OHM 1/2W 1% METAL FILM | 3101430 | 7115 |
| R250 | RESISTOR, 10 OHM 1/4W 5% CARBON | 3070100 | 1121 |
| R251 | RESISTOR, 68 OHM 1W 5% CARBON | 3030680 | 1121 |
| R252 | RESISTOR, 100 OHM 1/4W 1% METAL FILM | 3131000 | 7115 |
| R253 | RESISTOR, 100 OHM 1/4W 1% METAL FILM | 3131000 | 7115 |
| R260 | RESISTOR, 10 OHM 1/4W 5% CARBON | 3070100 | 1121 |
| R261 | RESISTOR, 68 OHM 1W 5% CARBON | 3030680 | 1121 |
| R262 | RESISTOR, 1500 OHM 1W 5% CARBON | 3030152 | 1121 |
| R270 | RESISTOR, 453 OHM 1/2W 1% METAL FILM | 3104530 | 7115 |
| R271 | RESISTOR, 56.2 OHM 1/4W 1% METAL FILM | 3130562 | 7115 |
| R272 | RESISTOR, 41.2 OHM 1/8W 1% METAL FILM | 3180412 | 7115 |
| R273 | RESISTOR, 41.2 OHM 1/8W 1% METAL FILM | 3180412 | 7115 |
| R274 | RESISTOR, 10.0 OHM 1/8W 1% METAL FILM | 3180100 | 7115 |
| R300 | RESISTOR, 100 OHM 1/8W 1% METAL FILM | 3181000 | 7115 |
| R301 | RESISTOR, 100 OHM 1/8W 1% METAL FILM | 3181000 | 7115 |
| R302 | RESISTOR, 100 OHM 1/8W 1% METAL FILM | 3181000 | 7115 |
| R303 | RESISTOR, 100 OHM 1/8W 1% METAL FILM | 3181000 | 7115 |
| R304 | RESISTOR, 100 OHM 1/8W 1% METAL FILM | 3181000 | 7115 |
| R305 | RESISTOR, 100 OHM 1/8W 1% METAL FILM | 3181000 | 7115 |
| R306 | RESISTOR, 100 OHM 1/8W 1% METAL FILM | 3181000 | 7115 |
| R307 | RESISTOR, 100 OHM 1/8W 1% METAL FILM | 3181000 | 7115 |
| R308 | RESISTOR, 100 OHM 1/8W 1% METAL FILM | 3181000 | 7115 |
| R309 | RESISTOR, 100 OHM 1/8W 1% METAL FILM | 3181000 | 7115 |
| R310 | RESISTOR, 100 OHM 1/8W 1% METAL FILM | 3181000 | 7115 |
| R311 | RESISTOR, 100 OHM 1/8W 1% METAL FILM | 3181000 | 7115 |
| R312 | RESISTOR, 332 OHM 1/4W 1% METAL FILM | 3133320 | 7115 |
| R313 | POTENTIOMETER, 100 OHM TRIM | 3110141 | 71450 |
| R314 | RESISTOR, 100 OHM 1/8W 1% METAL FILM | 3181000 | 7115 |
| R315 | RESISTOR, 1500 OHM 1/4W 1% METAL FILM | 3131501 | 7115 |
| R316 | POTENTIOMETER, 500 OHM TRIM | 3110142 | 71450 |
| R317 | RESISTOR, 442 OHM 1/4W 1% METAL FILM | 3134420 | 7115 |
| R318 | RESISTOR, SELECTED VALUE | | |
| R319 | CONCENTRIC SWITCH & POTENTIOMETER | 2600313 | 71450 |
| R320 | RESISTOR, 24900 OHM 1/4W 1% METAL FILM | 3132492 | 7115 |
| R321 | RESISTOR, 100K OHM 1/4W 1% METAL FILM | 3131003 | 7115 |
| R322 | RESISTOR, 100K OHM 1/4W 1% METAL FILM | 3131003 | 7115 |
| R324 | POTENTIOMETER, 100K OHM TRIM | 3110143 | 71450 |
| R325 | RESISTOR, 100K OHM 1/4W 1% METAL FILM | 3131003 | 7115 |
| R326 | RESISTOR, 4990 OHM 1/4W 1% METAL FILM | 3134991 | 7115 |
| R327 | RESISTOR, 1500 OHM 1/4W 5% CARBON | 3070152 | 1121 |
| R328 | RESISTOR, 100K OHM 1/4W 1% METAL FILM | 3131003 | 7115 |
| R330 | RESISTOR, 499 OHM 1/4W 1% METAL FILM | 3134990 | 7115 |
| R331 | RESISTOR, 1500 OHM 1/4W 5% CARBON | 3070152 | 1121 |
| R332 | RESISTOR, 100K OHM 1/4W 1% METAL FILM | 3131003 | 7115 |
| R333 | POTENTIOMETER, 100K OHM TRIM | 3110143 | 71450 |
| R340 | RESISTOR, 806 OHM 1/4W 1% METAL FILM | 3138060 | 7115 |
| R351 | RESISTOR, 5100 OHM 1/4W 5% CARBON | 3070512 | 1121 |
| R352 | RESISTOR, 806 OHM MATCHED PAIR | 3128060 | 10597 |
| R353 | RESISTOR, 2700K OHM 1/4W 5% CARBON | 3070275 | 1121 |
| R354 | POTENTIOMETER, 100K OHM TRIM | 3110143 | 71450 |
| R360 | RESISTOR, 1500 OHM 1/4W 5% CARBON | 3070152 | 1121 |
| R370 | RESISTOR, 100 OHM 1/4W 5% CARBON | 3070101 | 1121 |
| R381 | RESISTOR, 1500 OHM 1/4W 5% CARBON | 3070152 | 1121 |
| R390 | RESISTOR, 100 OHM 1/4W 5% CARBON | 3070101 | 1121 |
| R391 | RESISTOR, 20000K OHM 1/4W 5% CARBON | 3070206 | 1121 |
| R392 | POTENTIOMETER, 100K OHM TRIM | 3110143 | 71450 |
| R401 | RESISTOR, 80600 OHM MATCHED PAIR | 3128062 | 10597 |
| R402 | RESISTOR, 8060 OHM MATCHED PAIR | 3128061 | 10597 |
| R403 | RESISTOR, 806 OHM MATCHED PAIR | 3128060 | 10597 |
| R409 | RESISTOR, 442 OHM 1/4W 1% METAL FILM | 3134420 | 7115 |
| R410 | RESISTOR, 51 OHM 1/4W 5% CARBON | 3070510 | 1121 |
| R430 | RESISTOR, 160 OHM 1/2W 5% CARBON | 3010161 | 1121 |
| R431 | RESISTOR, 402 OHM 1/4W 1% METAL FILM | 3134020 | 7115 |
| R440 | RESISTOR, 383 OHM 1/4W 1% METAL FILM | 3133830 | 7115 |
| R450 | RESISTOR, 4220 OHM 1/4W 1% METAL FILM | 3134221 | 7115 |
| R451 | RESISTOR, 402 OHM 1/4W 1% METAL FILM | 3134020 | 7115 |
| R460 | RESISTOR, 4220 OHM 1/4W 1% METAL FILM | 3134221 | 7115 |
| R461 | POTENTIOMETER, 500 OHM TRIM | 3110142 | 71450 |
| R462 | RESISTOR, 4320 OHM 1/4W 1% METAL FILM | 3134321 | 7115 |
| R463 | RESISTOR, 4320 OHM 1/4W 1% METAL FILM | 3134321 | 7115 |
| R464 | POTENTIOMETER, 500 OHM TRIM | 3110142 | 71450 |
| R465 | RESISTOR, 274 OHM 1/4W 1% METAL FILM | 3132740 | 7115 |
| R470 | RESISTOR, 2210 OHM 1/4W 1% METAL FILM | 3132211 | 7115 |
| R471 | RESISTOR, 10000 OHM 1/4W 1% METAL FILM | 3131002 | 7115 |
| R472 | RESISTOR, 3010 OHM 1/4W 1% METAL FILM | 3133011 | 7115 |
| R480 | RESISTOR, 619 OHM 1/4W 1% METAL FILM | 3136190 | 7115 |
| R481 | RESISTOR, 475 OHM 1/4W 1% METAL FILM | 3134750 | 7115 |
| R482 | RESISTOR, 715 OHM 1/4W 1% METAL FILM | 3137150 | 7115 |
| R490 | RESISTOR, 475 OHM 1/4W 1% METAL FILM | 3134750 | 7115 |
| R500 | RESISTOR, 120 OHM 1W 5% CARBON | 3030121 | 1121 |
| R501 | RESISTOR, 1000 OHM 1/4W 5% CARBON | 3070102 | 1121 |
| R510 | RESISTOR, 2400 OHM 1/4W 5% CARBON | 3070242 | 1121 |
| R520 | RESISTOR, 100 OHM 1/4W 5% CARBON | 3070101 | 1121 |
| R530 | RESISTOR, 5100 OHM 1/4W 5% CARBON | 3070512 | 1121 |
| R531 | RESISTOR, 160 OHM 1/2W 5% CARBON | 3010161 | 1121 |
| R532 | POTENTIOMETER, 500 OHM TRIM | 3110142 | 71450 |
| R533 | RESISTOR, 750 OHM 1/4W 1% METAL FILM | 3137500 | 7115 |
| R540 | RESISTOR, 5100 OHM 1/4W 5% CARBON | 3070512 | 1121 |
| R541 | RESISTOR, 750 OHM 1/4W 1% METAL FILM | 3137500 | 7115 |
| R542 | POTENTIOMETER, 500 OHM TRIM | 3110142 | 71450 |
| R550 | RESISTOR, 4700 OHM 1/4W 5% CARBON | 3070472 | 1121 |
| R551 | RESISTOR, 4700 OHM 1/4W 5% CARBON | 3070472 | 1121 |
| R552 | RESISTOR, 100 OHM 1/4W 5% CARBON | 3070101 | 1121 |
| S001 | SWITCH, TOGGLE SPDT | 2600103 | 100005 |
| S100 | CONCENTRIC SWITCH AND POTENTIOMETER | 2600311 | 71450 |
| S200 | SWITCH, MIN. ROTARY 3P3T | 2600090 | 76854 |
| S300 | CONCENTRIC SWITCH & POTENTIOMETER | 2600313 | 71450 |
| S400 | SWITCH, ROTARY 5P8T | 2600312 | 71450 |
| T001 | TRANSFORMER, POWER | 1200036 | 10597 |

# SECTION 7

# SCHEMATICS


| | |
|---|---|
| Figure 7.1.1 | Model 120 Parts Layout |
| Figure 7.1.2 | Model 123 Parts Layout |
| Figure 7.2.1 | Models 120 and 123 Generator Loop |
| Figure 7.2.2 | Models 120 and 123 Signal Shaping and Amplifying Circuits |

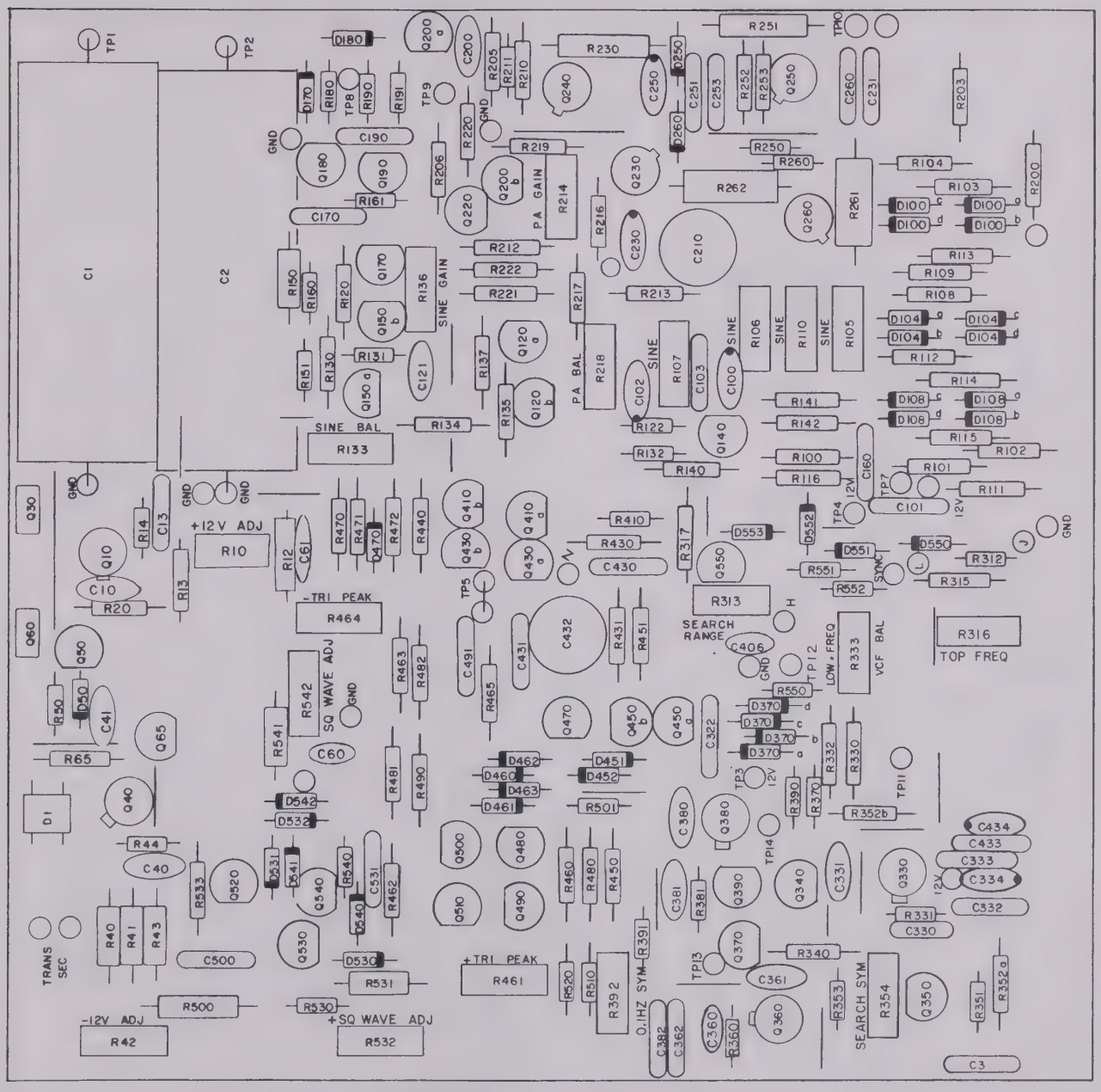



FIGURE 7.1.1 PARTS LAYOUT MODEL 120

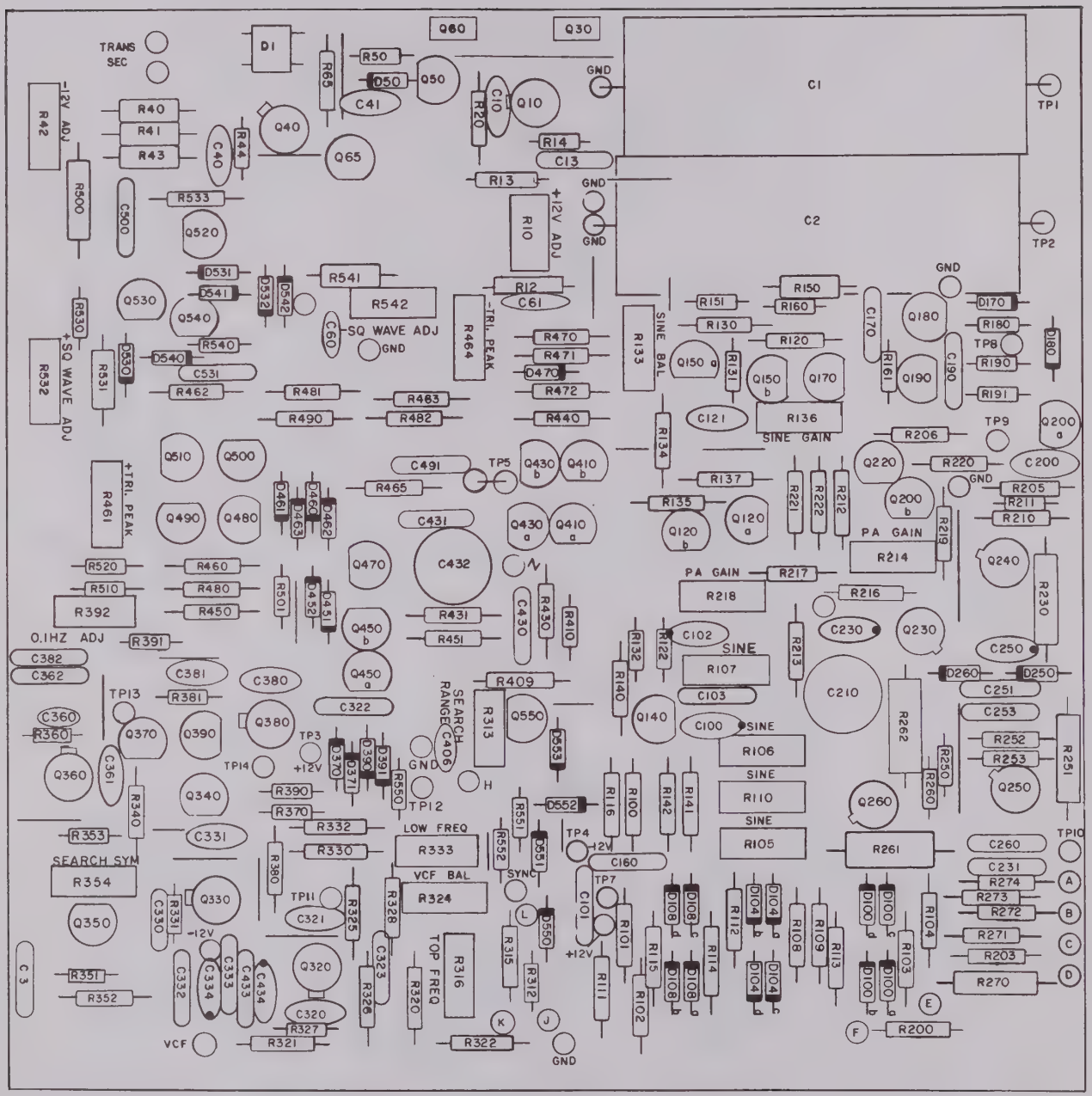



FIGURE 7.1.2 PARTS LAYOUT MODEL 123

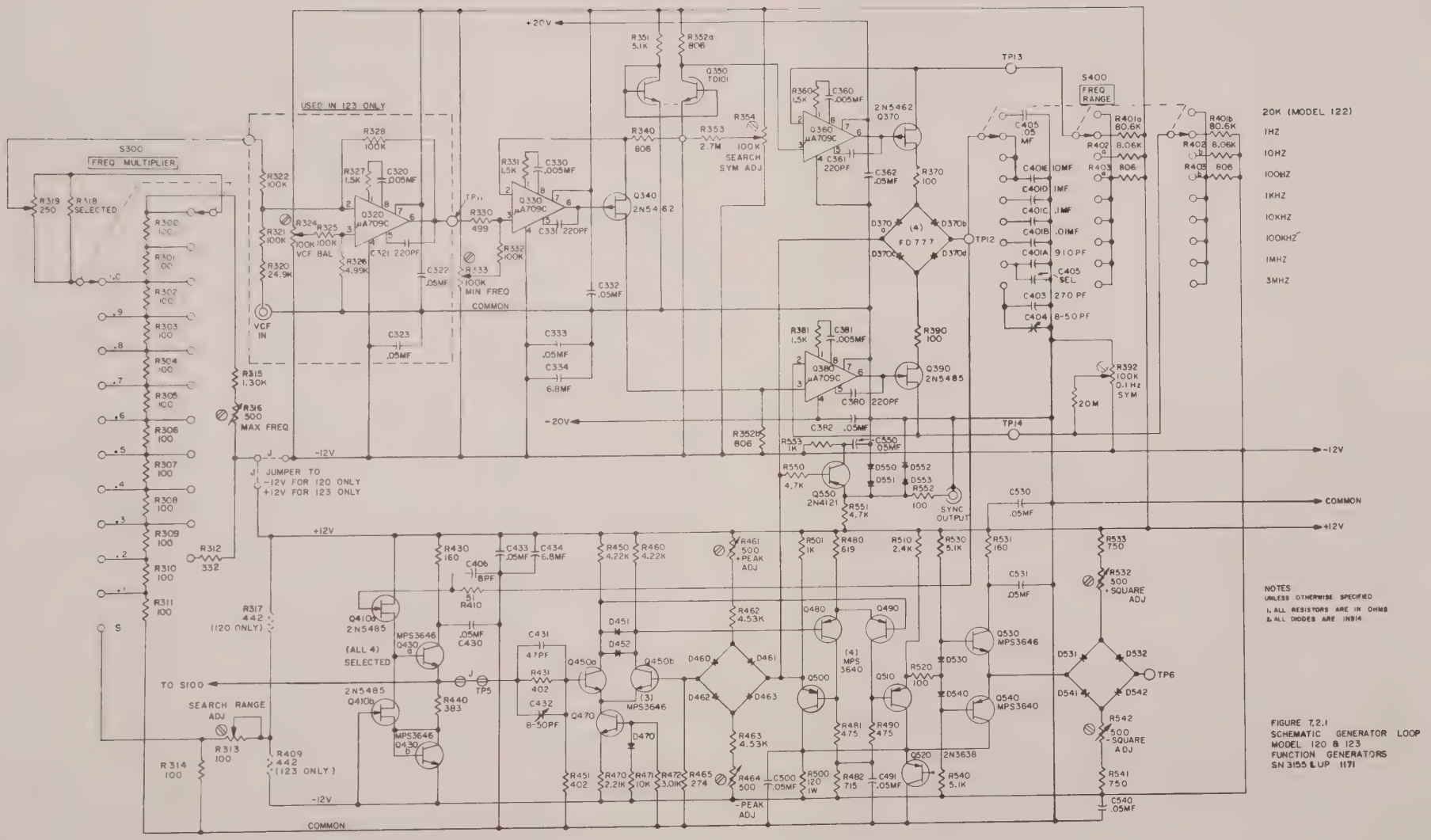



FIGURE 7.2.1
SCHEMATIC GENERATOR LOOP
MODEL 120 & 123
FUNCTION GENERATORS
SN 3155 & UP 1171

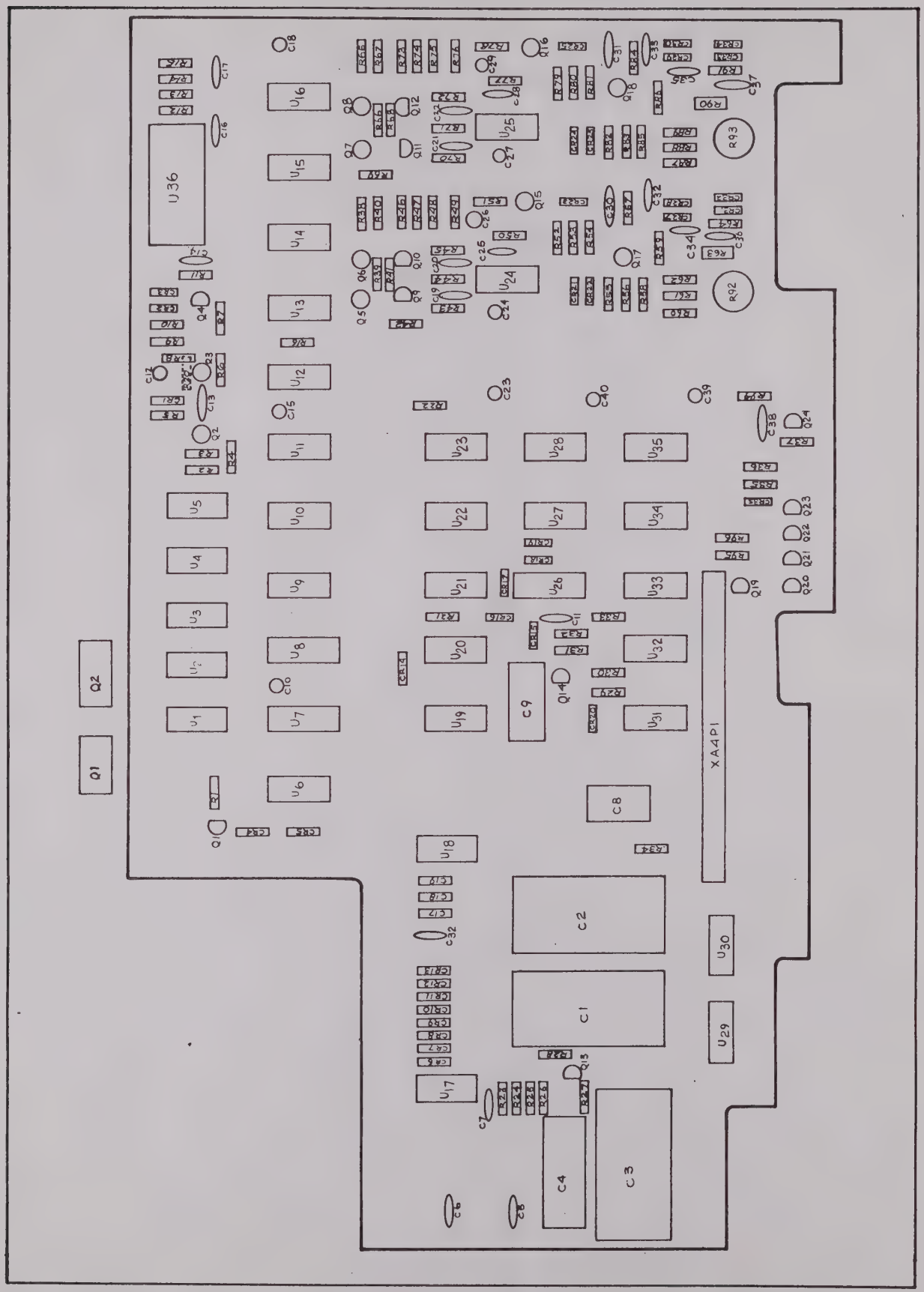



Figure 5-1. A1 - MAIN BOARD PCB ASSEMBLY

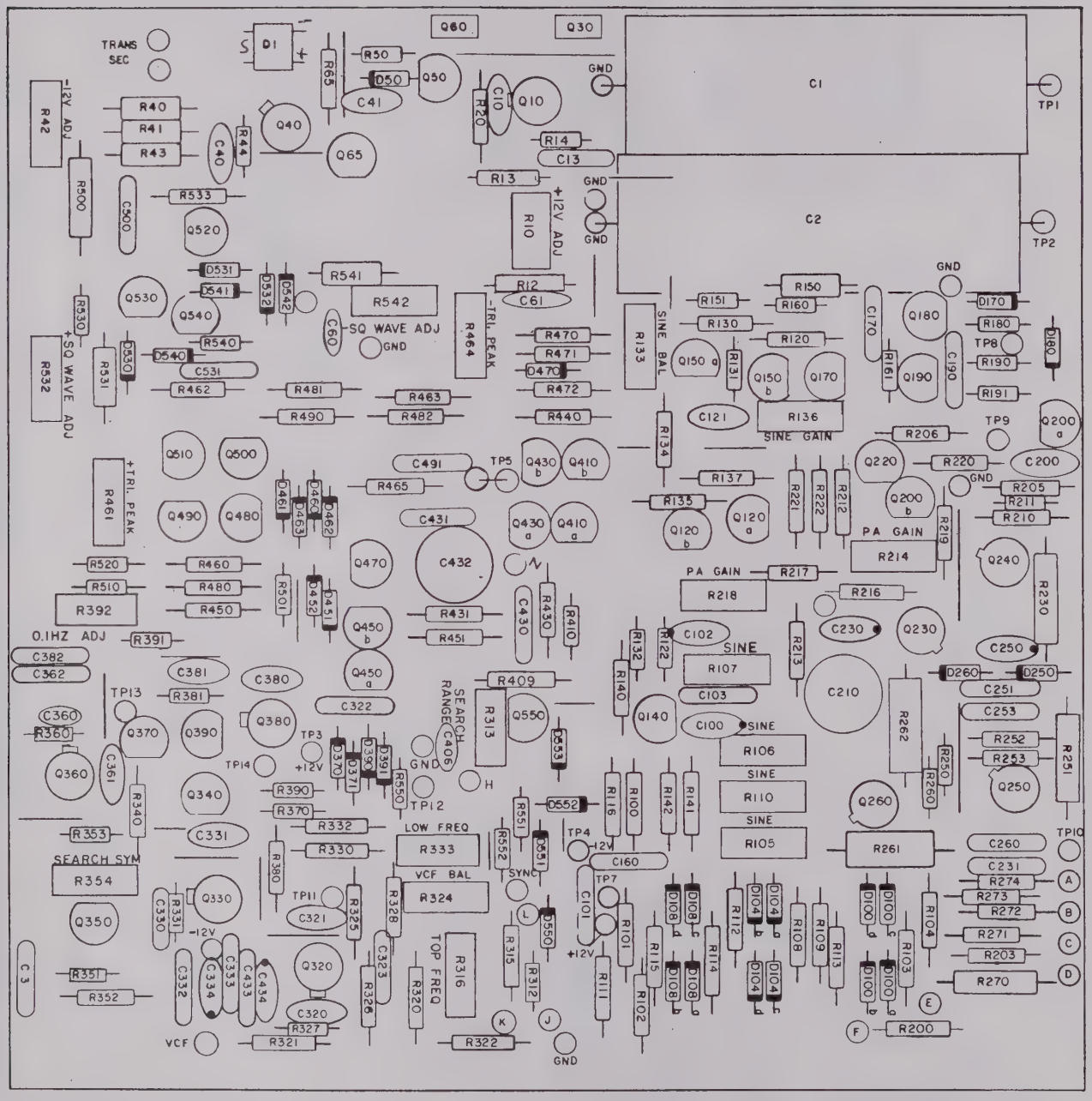
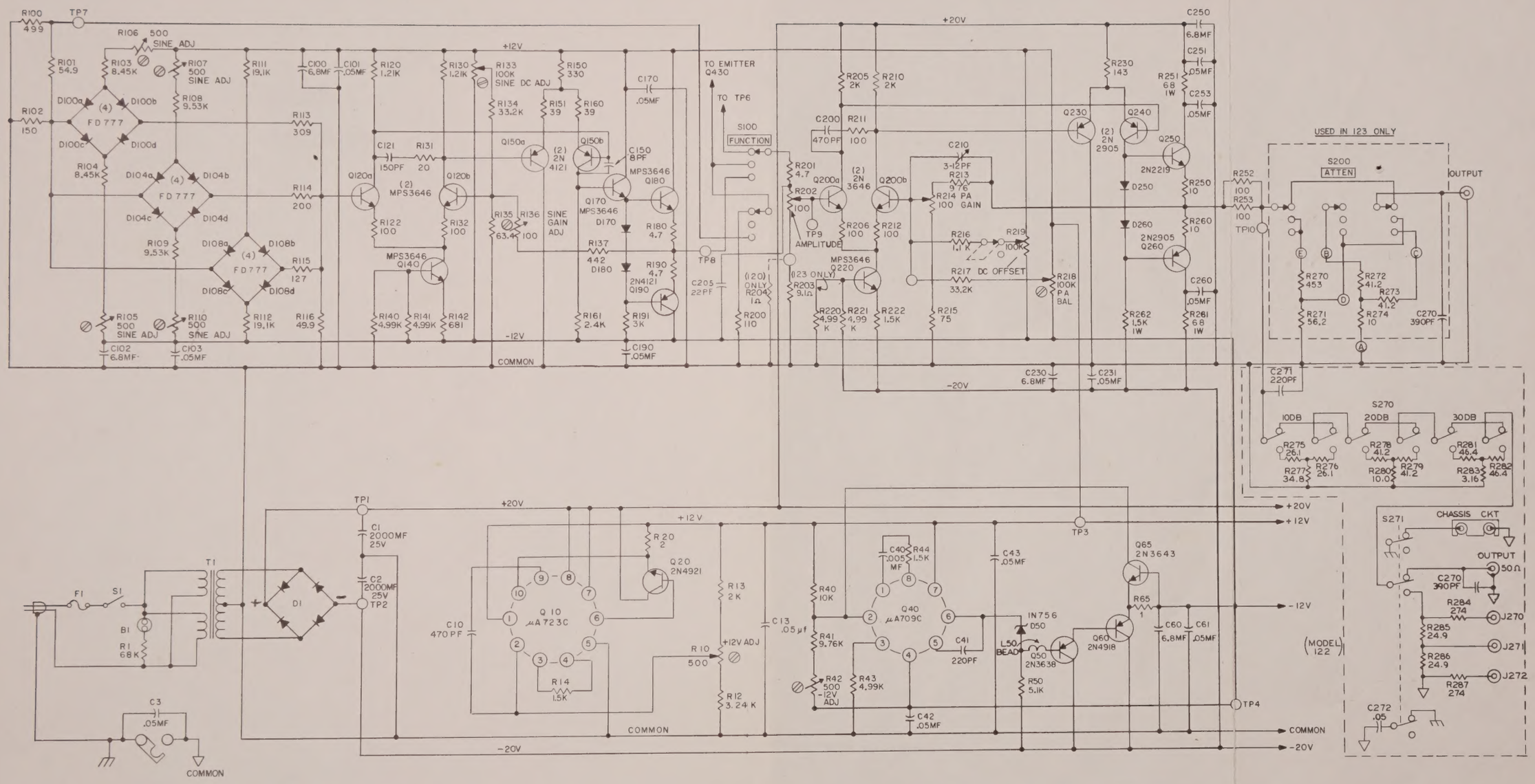



FIGURE 7.1.2 PARTS LAYOUT MODEL 123




NOTES
UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE IN OHMS
2. ALL DIODES ARE 1N914

FIGURE 7.2.2
SCHEMATIC, SIGNAL SHAPING & AMPLIFYING CIRCUITS
MODELS 120 & 123 FUNCTION GENERATORS
SN 3155 & UP 772

# SECTION 9

# ADDENDA